

# SERVICE TRAINING COURSE

BOOK NUMBER 3



## Models

**MA 7**

**\* Function**

**MA 7 - W**

**\* Adjustment**

**MA 7 - W . 3 . s**

**\* Nomenclature**

**GENERAL SERVICE DEPARTMENT  
MONROE CALCULATING MACHINE CO., INC.**

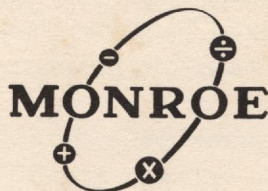






# SERVICE TRAINING COURSE

## Book No. 3



### SIXTEEN SECTIONS

- DEVELOPMENT OF THE "M" LINE
- IDENTIFYING FEATURES OF THE "M" LINE
- DIFFERENCES BETWEEN "L" AND "M"
- MODEL CODING
- SAFETY DEVICES
- COMPOSITE VIEWS AND NOMENCLATURE
- INTRODUCTION TO INDIVIDUAL AUTOMATIC PARTS
- SMALL DIAMETER CARRY SHAFT & WEDGE ACTION
- THE MA 7 CARRIAGE
- CARRIAGE CLEARING
- CARRIAGE SHIFT
- THE RETARD LEVER
- THE "TENS-CARRY" IN UPPER DIALS
- PART NUMBERS
- QUESTIONNAIRE
- DETAILS OF ADJUSTMENT



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## FOREWORD

Book #3 of the service training course will advance your training through the "M" line of calculators. The models of this line of machines are the M, MA, MA-3, MA-4, MA-5, MA-6, and MA-7. They comprise a large portion of our total field calculator population. Your knowledge of the L, LA, LA-5, LA-6, and LA-7 will prove of much help to you as you study the "M" mechanism. As you acquaint yourself with the "M" machines it will become apparent that one basic principle of design is used in all Monroe Calculators. Because of this, we must bear in mind the importance of acquiring a complete understanding of early models such as the "L" and "M" line in order to absorb training on later models such as the "C" line.

We desire that everything possible be done to enable you to learn easily and quickly, hence, issuance of this special service training course. Study carefully and intelligently. It will prepare you for the forthcoming study of many other interesting machines you will later be required to service.

From your study of Books #1 and #2, you have acquired an understanding of the following:

- Your Company and your job
- The Service Operation
- Parts Nomenclature
- Service Kit Tools
- Development of the entire "L" line
- \* Selection and Carry-over Principle
- Purposes of Individual Automatic Parts
- \* The Planetary Transmission
- \* Keyboard Actions
- The "L" line Carriage & Parts Function
- \* Cycle Control Mechanism - Function & Adjustment
- Lubrication of "L" models

In Book #3 we have concentrated on acquainting you with those mechanisms of the MA-7 which are outstandingly different in their purposes and movements from the mechanism of the LA-7 model.

The sections above, identified with an asterisk, apply to the MA-7 as well as the LA-7.



THE WELL TRAINED SERVICEMAN IS THE CONFIDENT SERVICEMAN.



## THE TRANSITION FROM THE "L" LINE TO THE "M" LINE

LN-200 + Pinch Lever Clearing of Carriage + Flexible Carriage Rail +  
5/8" keyboard spacing + larger overall size = M-210

### DEVELOPMENT AND FEATURES OF THE "M" MACHINES

<u>MODEL</u>		<u>PLUS OR MINUS</u>	<u>REVISION</u>	<u>BECAME MODEL</u>
M-170 or 210	➡	+	Complete Carry & Count- ing Upper Dials	M3-173 or 213
		+	Split Clearing of Upper Dials	
		+	Flexible Carriage Rail	
M-170 or 210		+	Motor	MA-170 or 210
MA-170 or 210		+	Split Clearing of Upper Dials	MA3-173 or 213
		+	Complete Carry & Counting Upper Dials	
		+	R.P.M. of 380	
MA3-173 or 213		+	Extra Carriage	MA-213
MA-213 (Dual Carriage)		+	Flexible Carriage Rail	MA-213-X
MA3-173 or 213		+	Automatic Division	MA4-173 or 213
MA4-173 or 213		+	R & L Shift Keys on Front of Machine	MA5-173 or 213
MA5-173 or 213		+	Automatic Shift From Plus Bar	
MA5-173 or 213		-	R & L Shift Keys on Front of Machine	MA6-173 or 213
MA6-173 or 213		+	Shift Bars Near Plus-Minus Bars	
		+	Front Bars Clearing of Car- riage Dials	MA7-173 or 213
		+	Front Bars Clearing of Key- board	
		+	R.P.M of 650	



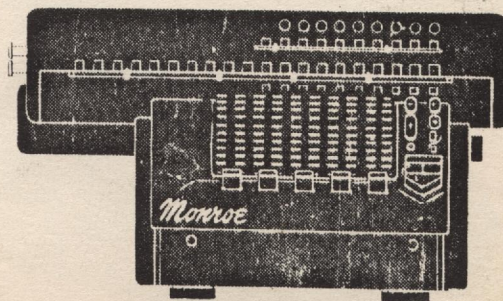
# DEVELOPMENT AND FEATURES OF THE "M" MACHINES (CONT'D.)

MA7-173 or 213	-	Upper L.H. Counting Dials	} MA7-W-173 or 213
	+	Auto. Division Lever Coupled to Change Lever	
	+	Auto. Return of Change Lever from KB Clear Bar	
	+	R.P.M. of 650	
MA7-W-173 or 213	+	Complete Carry & Counting Upper Dials	} MA7-W3S-173 or 213
	+	Split Clearing of Upper & Lower Dials	
	+	R.P.M. of 650	
MA7-W3s-173 or 213	+	Short-Cut Automatic Multiplication	} MA8-213 - Officially identified as the A1, A1-W and AA1 Models
	+	Automatic Carriage Return	
	+	Two Division Levers	
	+	Constant Features	
	+	R.P.M. of 650	

This terminated the production of "M" line Monroe Calculators and



Production was started on the "C" Line of Monroe Calculators, CAA, CSA, CST.

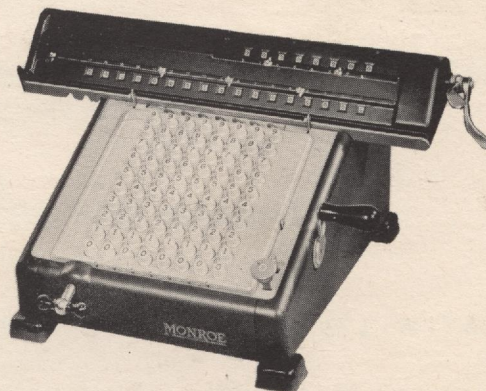




## IDENTIFYING FEATURES OF THE "M" LINE

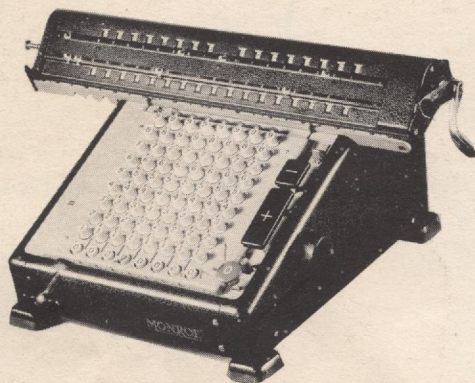
### The M 170

- HAND OPERATED
- "PINCH" LEVERS FOR CLEARING UPPER & LOWER DIALS
- SINGLE REPEAT, NON-REPEAT KEY
- GLIDING ACTION CARRIAGE



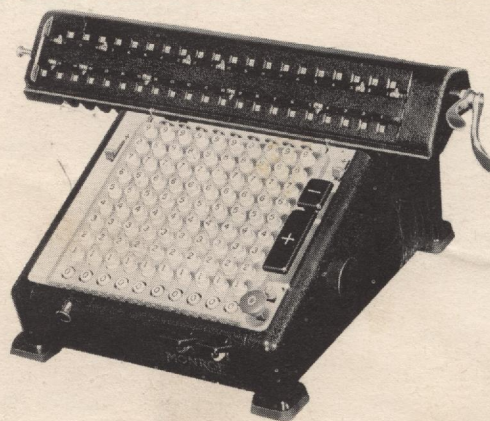
### The MA 3

- ELECTRIC MOTOR OPERATED
- PLUS & MINUS BARS
- TWO SETS UPPER DIALS (CARRY & COUNTING)
- SPLIT CLEARING OF UPPER DIALS
- LOCKED FIGURE KEYBOARD
- REVERSE CHANGE LEVER TO CONTROL UPPER DIAL DIRECTION OF ROTATION



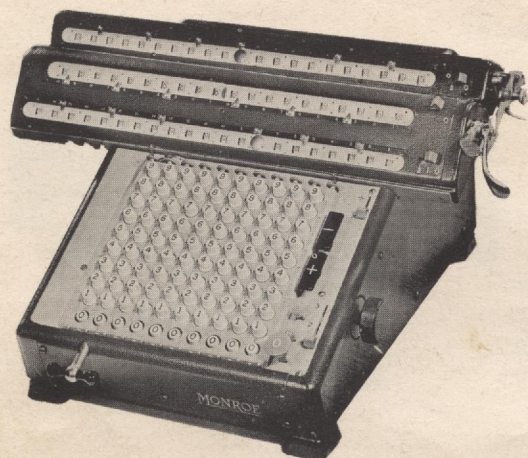
### The MA 5

- AUTOMATIC DIVISION
- AUTOMATIC SHIFT BARS ON FRONT



### The MA-X

- TWO CARRIAGES
- TWO SETS OF COUNTING DIALS
- COUPLED PINCH CLEARING LEVERS FOR CARRIAGE
- SPLIT CLEARING OF ALL DIALS
- HALF-CENT DIALS
- REPEAT & NON-REPEAT KEYS



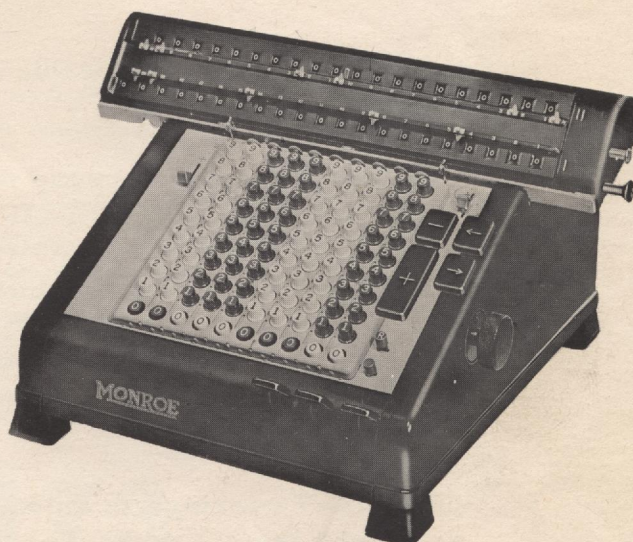


## IDENTIFYING FEATURES OF THE "M" LINE

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### The MA 7

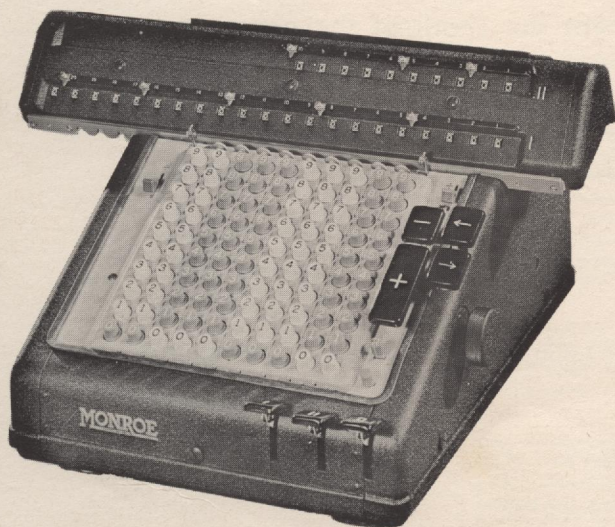
- CARRIAGE CLEARING BARS ON FRONT OF MACHINE
- CARRIAGE SHIFT BARS ON KEYBOARD
- MASTER CLEAR BAR ON FRONT OF MACHINE
- SPLIT CLEARING OF UPPER DIALS
- TWO SETS OF UPPER DIALS (CARRY & COUNTING)
- AUTOMATIC DIVISION



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### The MA 7.W

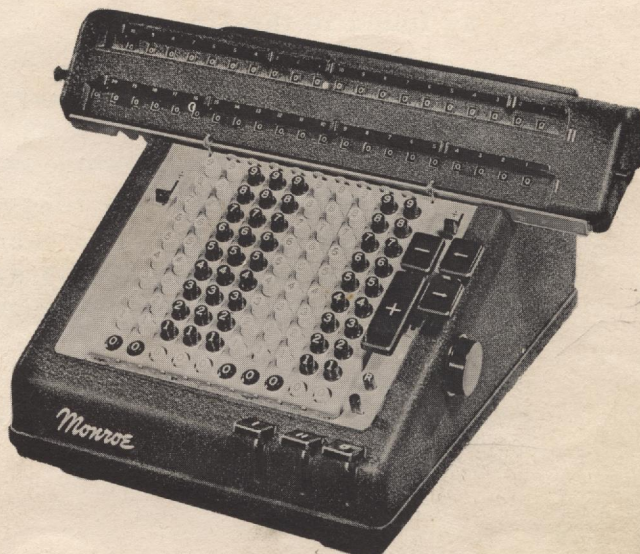
- NEW STYLE COVER CASE
- UPPER R.H. CARRY DIALS ONLY
- FOUR-POSITION REVERSE CHANGE LEVER



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### The MA 7.W.3.s

- TWO SETS OF UPPER DIALS (CARRY & COUNTING)
- SPLIT CLEARING OF UPPER & LOWER DIALS
- FOUR-POSITION REVERSE CHANGE LEVER





## DIFFERENCES BETWEEN "L" AND "M"

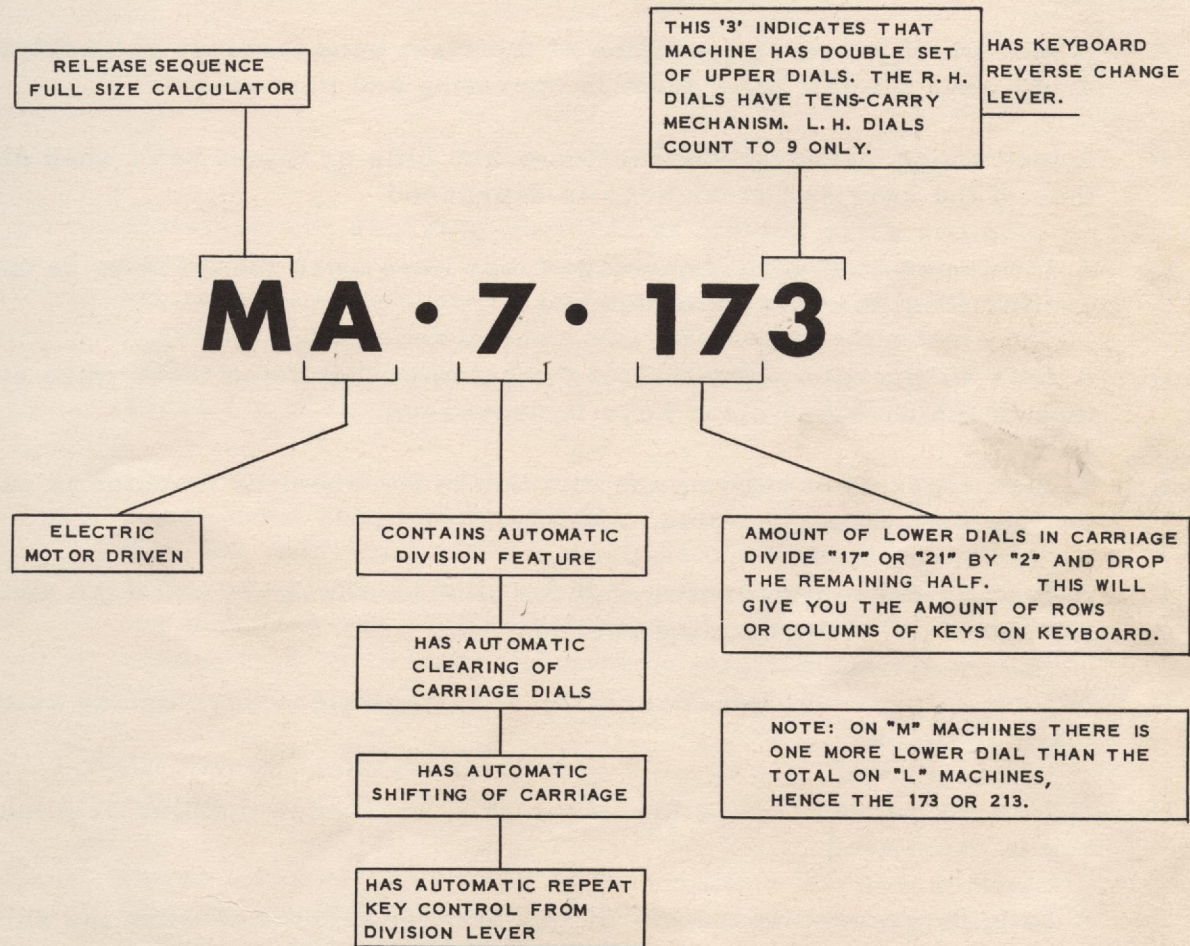
Some of the outwardly noticeable differences of the MA-7W3 Model as compared to the LA-7 Model:

- A. The MA-7 spacing between numeral keytops is 5/8". The LA-7 spacing is 1/2".
- B. The MA-7 over-all size is considerably larger than the LA-7.
- C. The MA-7 width is standard for both 8 and 10 bank machines. LA-7 machines vary in width depending on the amount of banks (or rows of keys).
- D. The MA-7 carriage is automatically cleared. Other "M" Models use a "pinch" lever type of clearing. The LA-7 employs a hand crank for manual carriage clearing.
- E. The MA-7 has three bars protruding from the front of the cover case, used for clearing the carriage and keyboard.
- F. The MA-7 carriage is moved sidewise automatically by spiral cams located in the rear of the machine. It does not have a front shift-rod as does the LA-7.
- G. The MA-7 color scheme is different.
- H. Automatic shift keys for the carriage are used on the MA-7, adjacent to the plus and minus keys.
- J. Various "bail" parts are used in the MA-7.
- K. The sun pinion has an extra gear.
- L. The MA-7 dials are held in position by check pawls - not by plungers as found in the LA-7.
- M. No clearout crank, circular lift cam, or trip pawls, are used in the MA-7.
- N. In the MA-7 Model, the hinge rod is of two parts. It serves not only as a hinge rod but its two sections are also employed to clear the upper and lower dials. The LA-7 hinge rod is a single part.



## MODEL CODING

The chart below illustrates the decoding of a model designation. Notice that every letter and numeral has a definite meaning.



There are three styles of MA-7 Models:

- MA-7 - This Model has noticeable legs and a shift knob on the right end of carriage. It has a two-position reverse lever and a double set of upper dials.
- MA-7W - This Model has a four-position reverse lever for upper dials. It has one set of upper dials and its feet are concealed.
- MA-7·W·3·s This Model has a double set of upper dials identical to the MA-7 and also split clearance of the dials. It has concealed feet.



## SAFETY DEVICES OF THE MA-7

The MA-7, unlike the LA-7, is equipped with an extensive set of operation locks to prevent misoperation when an operator attempts to perform conflicting functions simultaneously. This cross-locking mechanism is as follows:

- A. A lock which prevents operation of the right hand carriage shift spiral drum when the left hand drum is operating and vice versa.
- B. A lock which prevents depression of the plus or minus keys when either of the carriage clear keys is depressed.
- C. A lock operation of the carriage clear keys when the machine is operating from the plus or minus key.
- D. A lock to prevent operation of the automatic division lever when either of the carriage clear keys is depressed.
- E. A lock to prevent shifting the division lever when the machine is operated from either the plus or minus key.
- F. A lock to prevent depression of the plus or minus key when the division lever is in the dividing position.
- G. A lock to prevent operation of the carriage clear keys during automatic division;
- H. A lock to prevent operation of the shift keys when the plus or minus key is depressed.
- J. A lock to prevent operation of the plus or minus key when the shift keys are depressed.
- K. A lock to prevent operation of the shift keys during automatic division.
- L. A lock to prevent operation of the plus key or minus key when the carriage is raised beyond its normal shifting elevation.
- M. A lock to prevent automatic movement of the clutch yoke from its position during automatic division carriage shift.
- N. A lock to prevent depression of keyboard keys when machine is out of neutral.
- P. A lock to prevent depression of the plus or minus keys when machine mechanism is out of neutral.
- Q. A lock to prevent depression of the plus key when the minus key is depressed and vice versa.



## SAFETY DEVICES OF THE MA-7 (CONT'D.)

- R. A lock to prevent raising the carriage when the machine is off neutral.
- S. A lock to hold the clutch yoke in neutral whenever the carriage positioning plunger rests against the face of the carriage lock ledge.

### MA 7 SERVICE NOTES

Bearings and engaging surfaces of moving parts require lubrication to avoid wear and binding. Factory approved lubricants are identified in General Service Bulletin #G-508. Apply oils and greases sparingly. Excessive applications collect dust and metal particles which could impair the operation of the mechanism.

Prior to removing parts from a moving mechanism having a fixed relationship to other adjacent parts, neutralize the parts and note the position of timing dots. This is necessary to ensure accurate reassembly. When timing dots are not available, employ a scribe (a pointed needle type steel rod) and scratch aligning marks on the related parts you are considering removing.

All parts must be absolutely free of all binds without springs.

Never leave a screw loose to free a part. If a part binds, find out why and correct it. Loose screws can cause you an unnecessary amount of trouble.

Tighten screws when assembling parts and you won't forget them.

See that all pins are in tight.

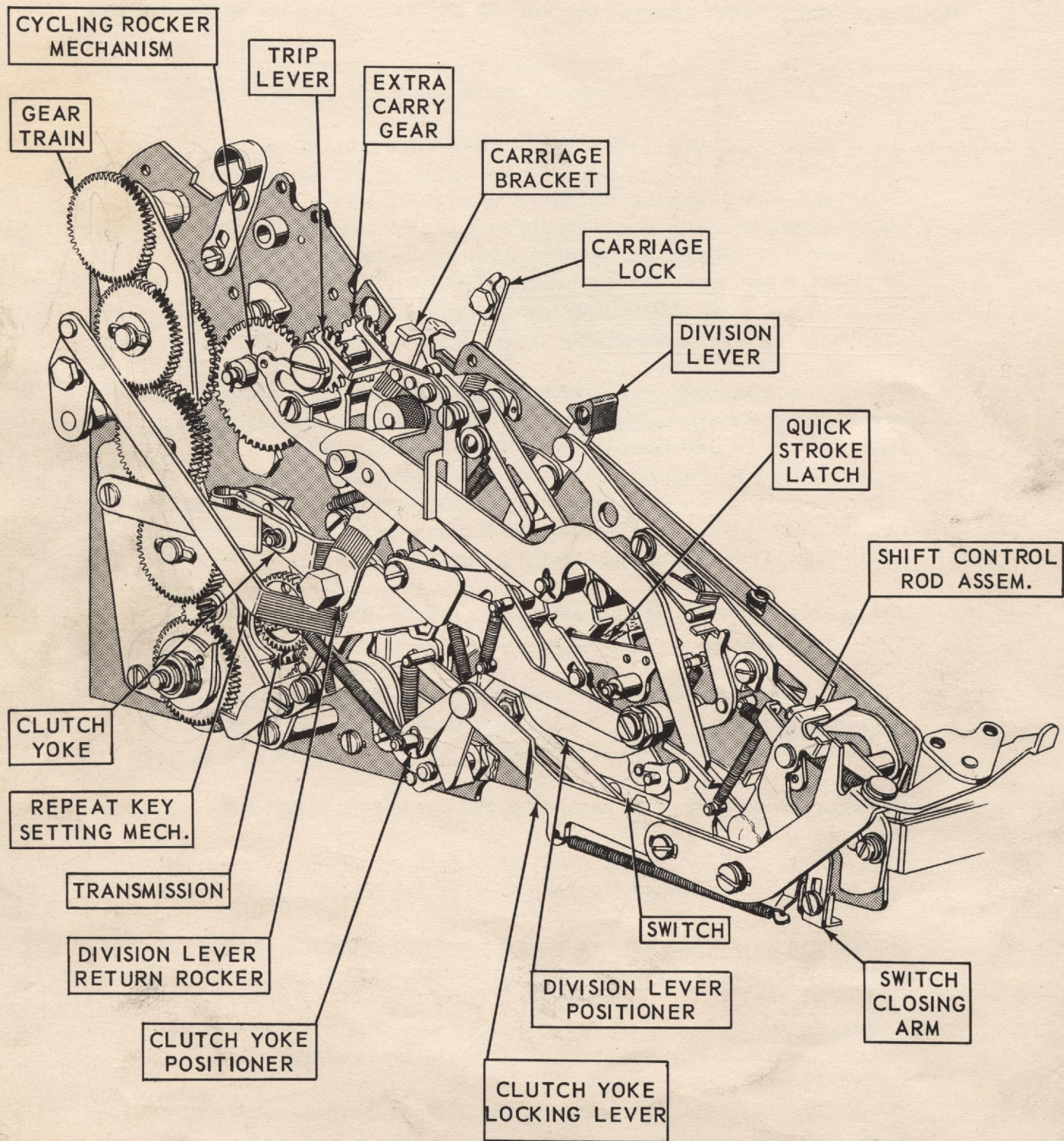
Never use force when assembling parts or sections; when properly aligned, parts will fit perfectly.

Learn to trace out each operation so you will understand the importance of each individual part, screw and stud.

Basic adjustments are very important to the proper operation of all models.

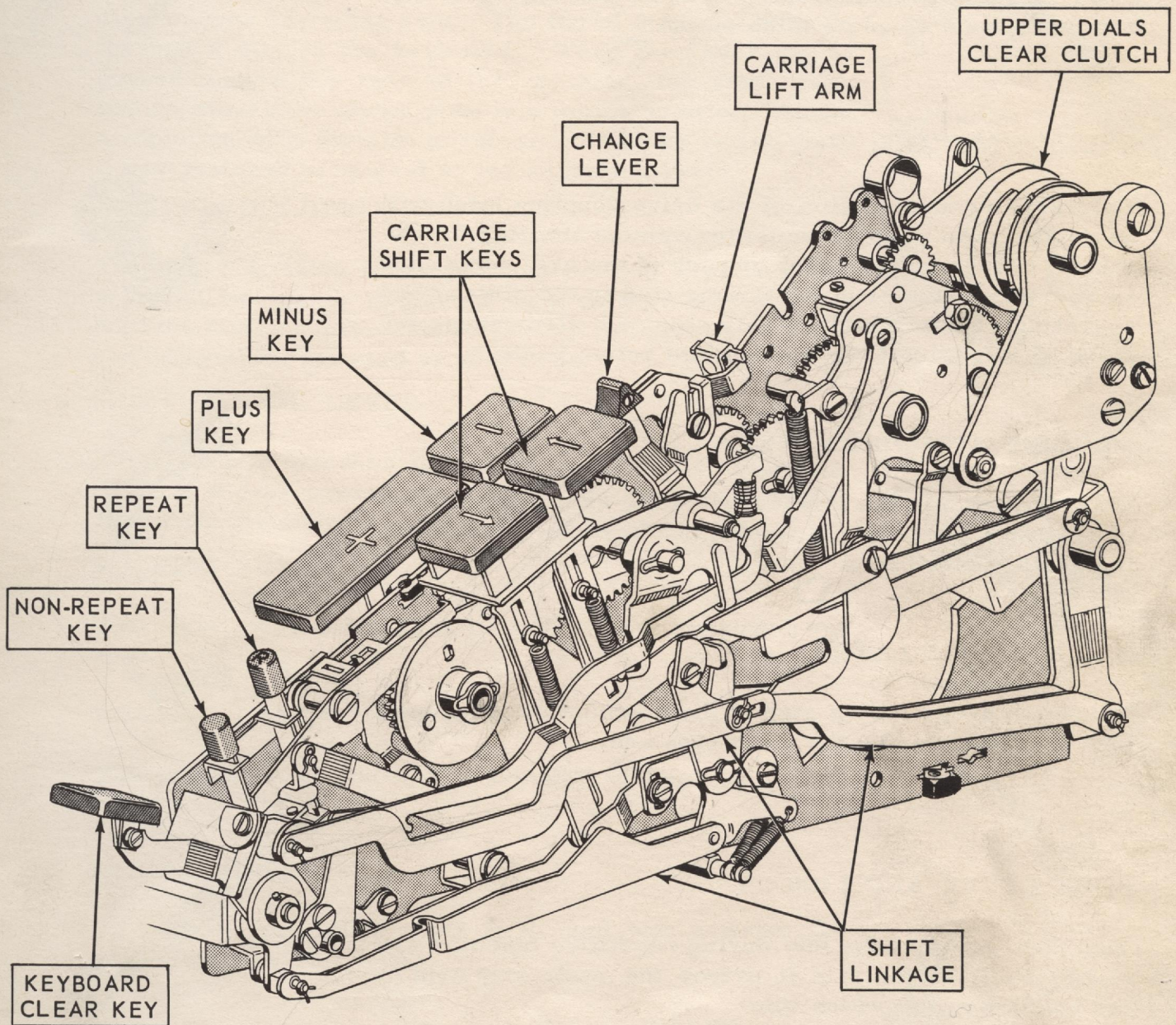


## LEFT SIDE FRAME NOMENCLATURE





## RIGHT SIDE FRAME NOMENCLATURE

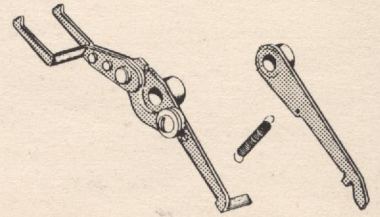




## INTRODUCTION TO INDIVIDUAL PARTS

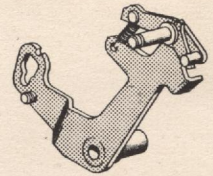
### TRIP LEVER

This lever is tripped (rocked) when engaged by a stud on an intermediate carriage gear. The rocking of the trip lever lifts an associated flexible arm. The lifting of this arm actuates a coupling latch on the



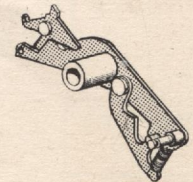
### CYCLE STOP ARM

This arm upon actuation of its drive coupling latch will be driven forward to a bumper (movement limiting bracket). In doing so, the lower section of the arm containing an aperture actuates a positioning stud on the clutch yoke operating arm assembly. This stop arm also causes the quick stroke latch to be rocked into active position.



### MACHINE STOPPING LEVER

This lever raises the trip lever flexible arm upon release of pressure from the plus and minus keystems due to being spring loaded by a



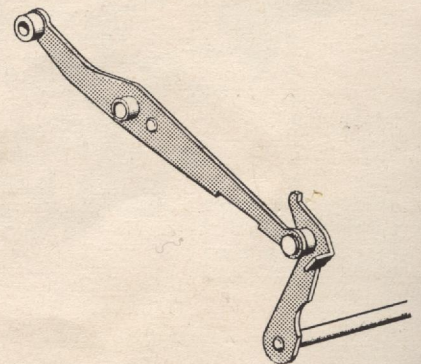
### QUICK STROKE LATCH

This latch drops over a step of the machine stopping lever. It is actuated by the cycle stop arm.



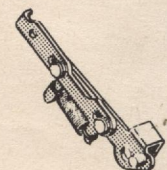
### ROCK LEVER AND LINK

The rock lever rocks idly during repetitive machine cycling. Following a trip it drives the cycle stop arm to the bumper pad at which time



### LOCATOR ARM

The locator arm moves upward when the clutch yoke is neutralized, to block the path of the rock lever and thereby assist in locating the cycling mechanism in neutral.

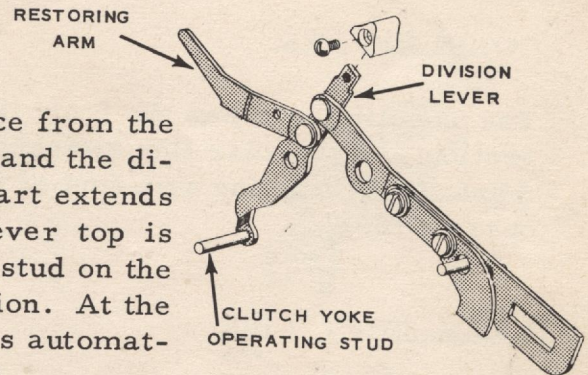




## INTRODUCTION TO INDIVIDUAL PARTS

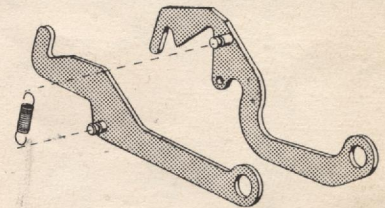
### DIVISION LEVER

The MA-7 division lever differs in appearance from the LA-7 lever because of the added locking parts and the division lever restoring arm. The top of this part extends through a slot in the keyboard. When the lever top is pushed toward the rear of the machine, the stud on the bottom moves the clutch yoke into minus position. At the completion of a division problem, this lever is automatically restored to neutral by the restoring arm.



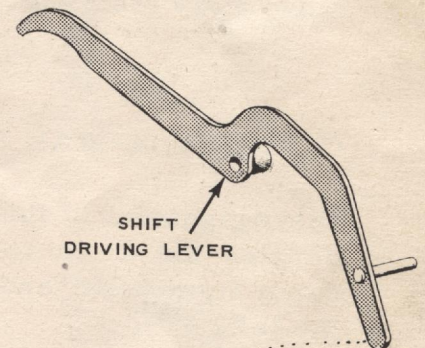
### POSITION HOLDING ARM

The MA-7 division lever position holding arm is composed of two parts connected by a spring. These arms hold the division lever securely in its two positions. They are adjustable, forward or rearward.



### SHIFT DRIVING LEVER

This lever is attached to a post on the cycle stop arm. When it moves toward the front of the machine during automatic division, it engages the shelf on the



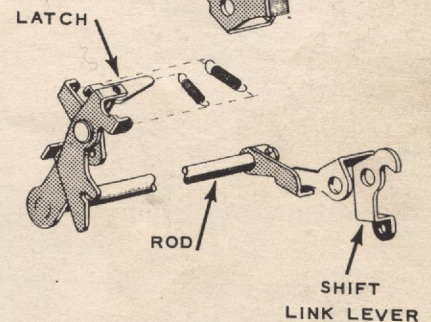
### ROCKING LEVER

This part rocks and causes its lug to move rearward and engage the



### ROCKING LATCH ASSEMBLY

The rocking latch which is assembled to the shift control rod causes the

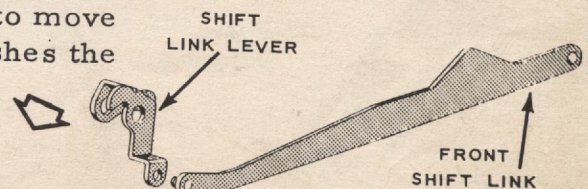


### SHIFT CONTROL ROD

To rock sharply. The rod's R.H. end will activate the shift-link operating lever.

### SHIFT LINK LEVER

Movement of the shift control rod pivots the shift link lever causing the bottom extension of the lever to move toward the rear of the machine. In doing so it pushes the



### FRONT SHIFT LINK

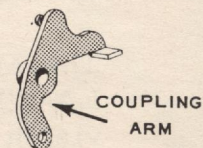
This link is attached to the lever extension and is pushed rearward, rocking the coupling arm.



## INTRODUCTION TO INDIVIDUAL PARTS

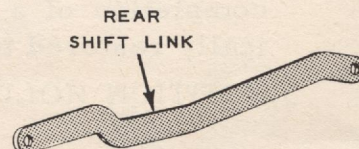
### COUPLING ARM

The coupling arm has the front link attached to its lower section and the rear link attached to its top. The movement of the coupling arm (out of its neutral position) will operate the



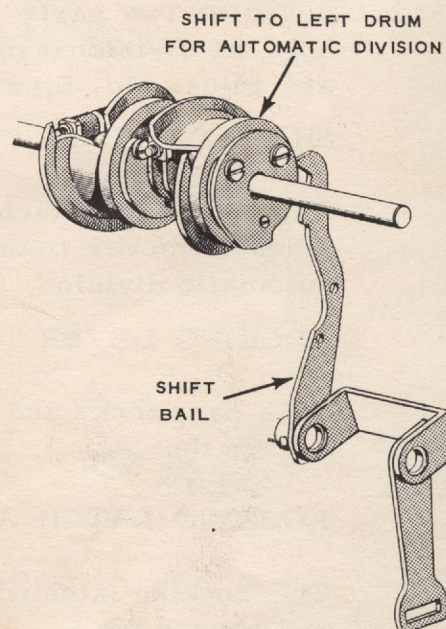
### REAR SHIFT LINK

This link will move toward the front of the machine and in doing so cause a pivoting of the



### SHIFT BAIL

The lower extension of this bail will be pulled toward the front of the machine causing the upper extension (arm) to move away from the

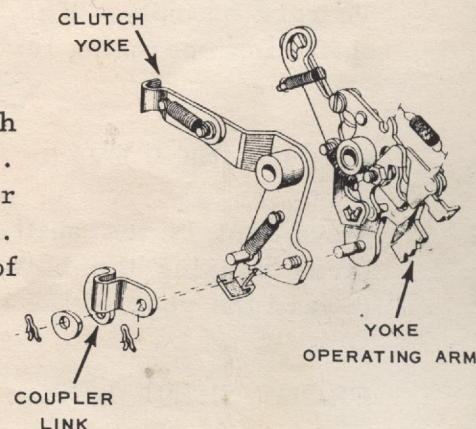


### CARRIAGE SPIRAL SHIFT DRUM

Disengagement of the bail arm from the pawl of the drum couples the drum to its rotating shaft. This causes the drum to revolve and its spiral will shift the carriage to the left.

### CLUTCH YOKE

The MA-7 clutch yoke is composed of two units; the clutch yoke section and the clutch yoke operating arm assembly. They are coupled together with a link. The division lever moves this two-part clutch yoke into operative position. The yoke causes the machine to reverse the direction of its cycling mechanism.

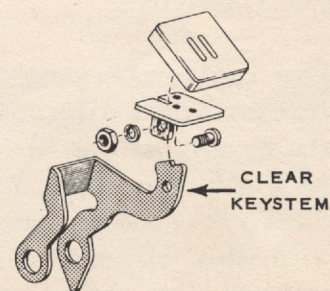




## INTRODUCTION TO INDIVIDUAL PARTS

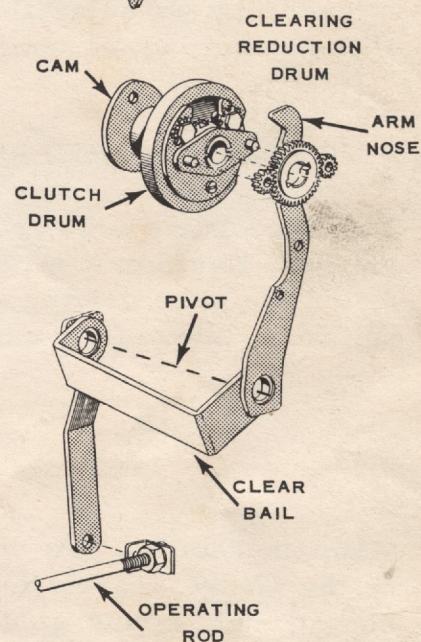
### CARRIAGE CLEAR KEY

Depression of a carriage clear key at the front of the machine moves the



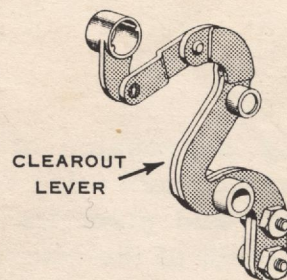
### CLUTCH BAIL OPERATING ROD

When either of these two rods are pulled toward the front of the machine, they cause the clear bail to be pivoted. This movement will move the bail arm nose away from the ratchet pawl of the dial clearout clutch drum. The cam of this clutch drum, when rotating, contacts the roller on the



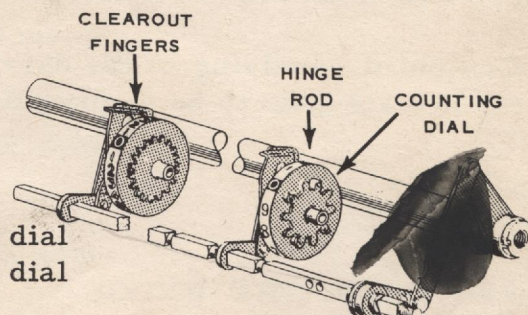
### UPPER DIALS CLEAROUT LEVER

The upper dials clearout lever, from the action of the cam, rotates the hinge rod section whose keyway slides through the sleeve of the clear lever. This rocking of the hinge rod causes



### CLEAROUT SHAFT


Carriage clearout shaft operation of the carriage dial clearout fingers. The fingers engage a cam on the dial and restore the dials to neutral or "zero" position.

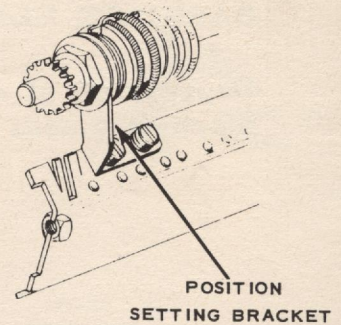




## SMALL DIAMETER CARRY SHAFT & WEDGE ACTION

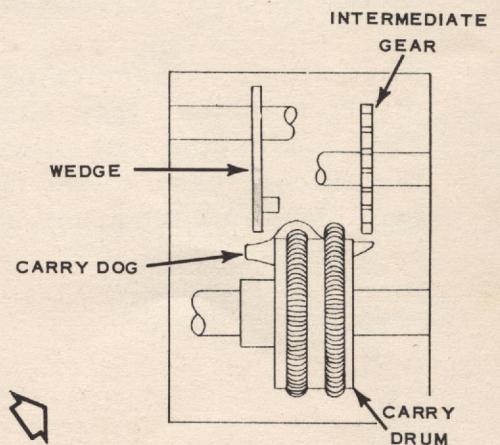
### POSITIONING


The main carrying shaft of the MA-7 has a smaller diameter and a different carry action than earlier "M" models or any of the "L" models. Machines with this smaller diameter shaft have a speed setting of 640 R.P.M. This MA-7 main carry shaft is held in sidewise alignment with the bottom engaging surfaces of the carry over wedges, by an adjustable guide bracket locked in place with two screws as shown in figure. 



### PIVOTING, NOT SLIDING

The "L" models and certain "M" model carry dogs, slide sidewise to affect a carry-over, see page 4-G of Book No. 2, but the gear driving end of the MA-7 carry dogs pivot upward to later effect contact with the intermediate gear.



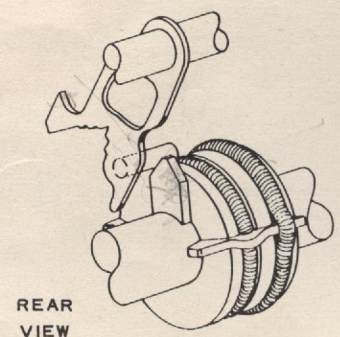
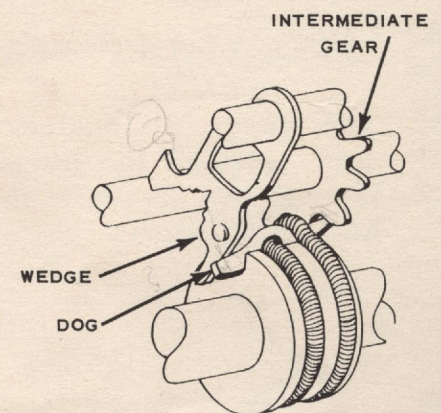
When in neutral, (no wedge depressed) the relationship of the wedge, carry dog and intermediate gear are as shown, one spring girdling the carry drum serves as a dog pivot bearing, the second spring restores the wedge to its neutral position. 

Following depression of a wedge, the revolving of the carry shaft causes a dog to contact the foot of the depressed wedge and pivot its opposite end upward into mesh with the teeth of the intermediate gear to the right. (Viewed from rear of machine)

Continued revolving of the carry shaft will cause the intermediate gear to be displaced one tooth.

### RESTORING THE WEDGE

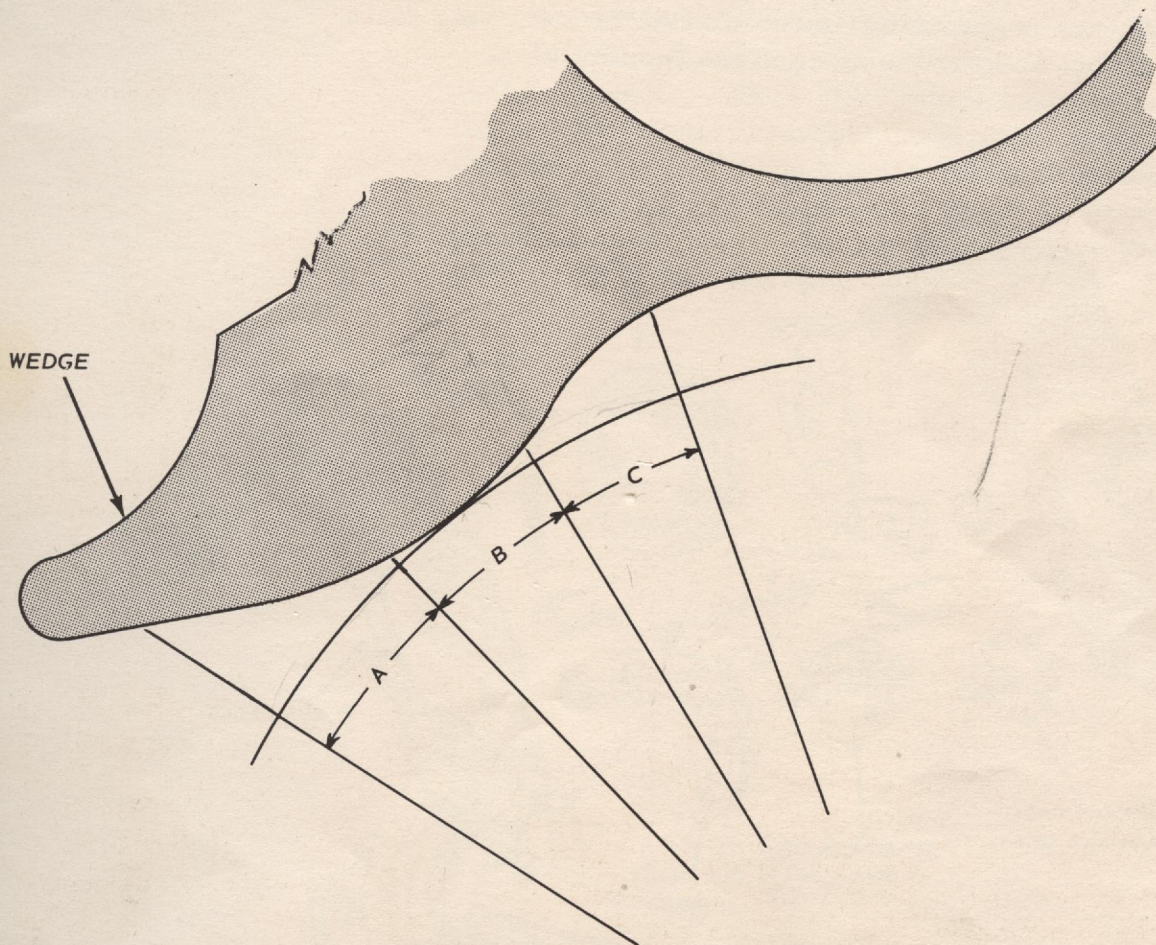
Restoring of the wedge to its upward position is achieved by engagement of a carry shaft lug with camming surfaces that engage the stud on the wedge and push it upward.





## THE WEDGE ACTION

The design of the bottom (foot) of the MA-7 wedge, differs from the LA-7 wedge in that the former does not have a right angle lug to activate the gear driving dogs of the main shaft. The MA-7 add and subtract dogs are operated from the bottom edge of the MA-7 wedge.



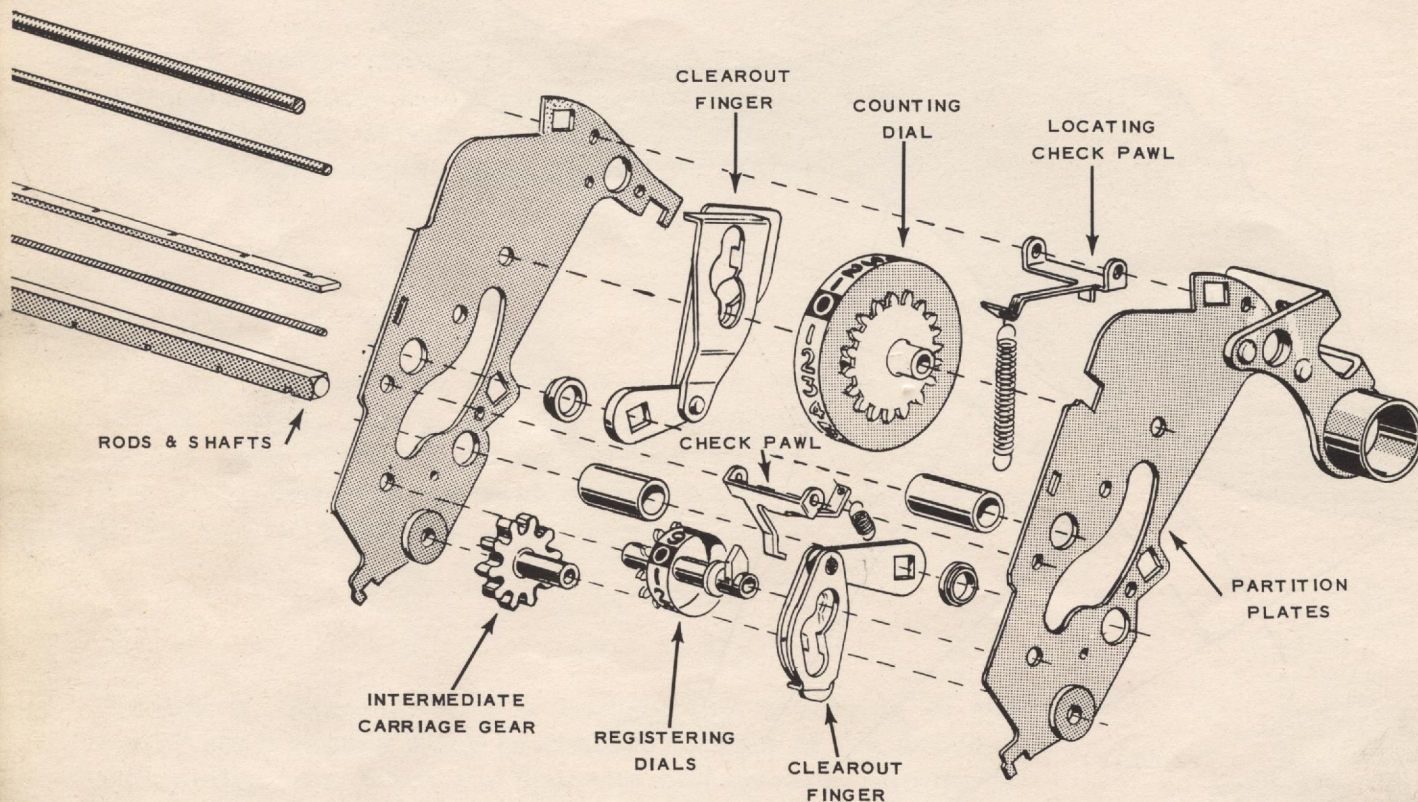
- A - Camming surface for moving subtract dog into mesh with intermediate gear.
- B - Surface of wedge utilized to hold dog in mesh with intermediate gear the proper length of time.
- C - Camming surface for moving add dog into mesh with intermediate gear.



## THE CARRIAGE

The carriage of the MA-7 is different in design from the LA-7 carriage. The LA-7 carriage is built into a shell or rigid frame, the MA-7 carriage is built of many separate plates and rods, which, when assembled, is called the carriage frame or skeleton. A sample of the parts located within one section of this frame is shown below.

There are three different kinds of dials used in the MA-7 carriage, the registering (lower dials), the carrying dials (upper right) and the counting dials (upper left).



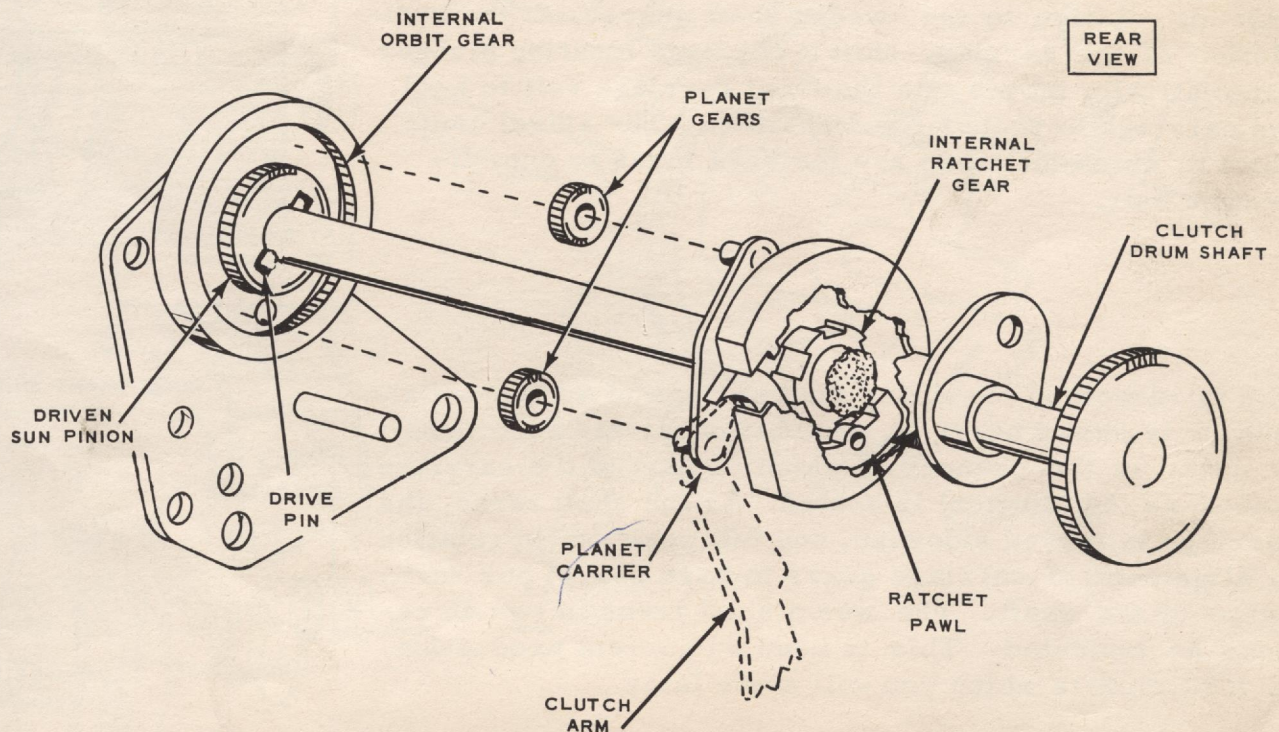
Buttons (knobs) protruding from the left and right sides of the carriage are used to control the automatic clearing of the upper and lower dials. Both sets of upper dials may be cleared simultaneously or the left hand dials alone may be cleared, depending on the setting of the R.H. button. The clearing of the lower dials may be divided "split" into two sections, one of which will clear or both sections may clear, through the use of the clearing control knob.



## CARRIAGE CLEARING

### CARRIAGE CLEAROUT SPEED REDUCTION UNIT

Rotation of the clutch drum shaft causes the drive pin to rotate the sun pinion which in turn drives the planet gears. The planet gears rotating on their horizontal posts of the planet carrier cause the internal ratchet gear to be driven in a counterclockwise direction (viewed from the rear). The ratchet pawl couples and uncouples the ratchet gear from the drum and its clearout operating cam depending on whether the clearout clutch arm nose is located in neutral position under the tip of the pawl or whether it is located outward. When the clutch arm is away from the drum, the drum, ratchet pawl, and ratchet become one moving unit. Note the similarity of this gearing with the explanation of a transmission found in Book No. 2. This points out the value of the progressive training method employed in this training course.

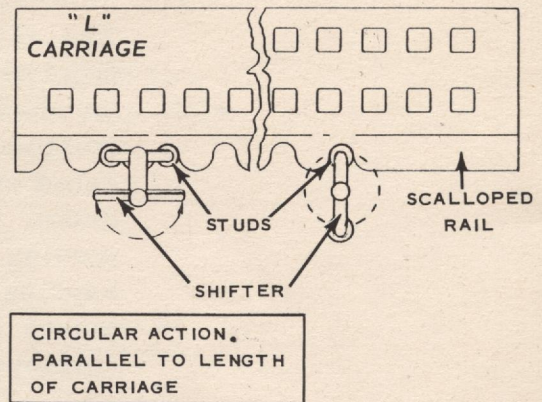




## CARRIAGE SHIFT

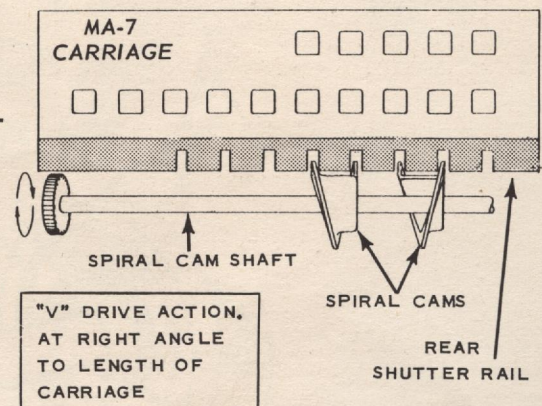
Three different mechanical methods are employed in Monroe Calculators for moving the carriage sidewise. In the "L" line of machines the carriage has a scalloped rail with a true ledge over which carriage hold down locks are positioned. These scallops fit over two studs attached to a shifter rod, which in turn is suspended from the upper keyboard plate. Either of these two studs can shift the carriage to the right or left, one position, and then also serve as the means of locating the carriage properly in relation to alignment with the wedge shaft gears. To permit convenient, continuous shift of the carriage in one direction, two studs are mounted on the yoke of the shift rod so that a complete  $360^\circ$  rotation of the "T" shape carriage shifter handle will move the carriage two full positions in the one direction. Automatically the LA-7 carriage shifts in one direction only. Manually it can be shifted in two directions.

"DIALING" OR CIRCULAR STYLE OF SHIFT



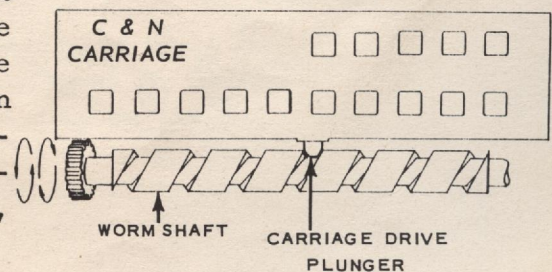
On the MA-7 models two spiral cams are used to move the carriage, one spiral for a shift to left and the other spiral for a shift to the right. The spiral cams are controlled so that only one can cycle at a time. A full turn of a spiral cam will shift the carriage one position sidewise in relation to the wedge shaft gears. At the completion of the carriage shift a carriage locating plunger automatically moves into the front carriage rail to hold the carriage in proper fixed position. The spiral cam shaft to which the cams are fastened turns in one direction only.

SPIRAL CAM SHIFT



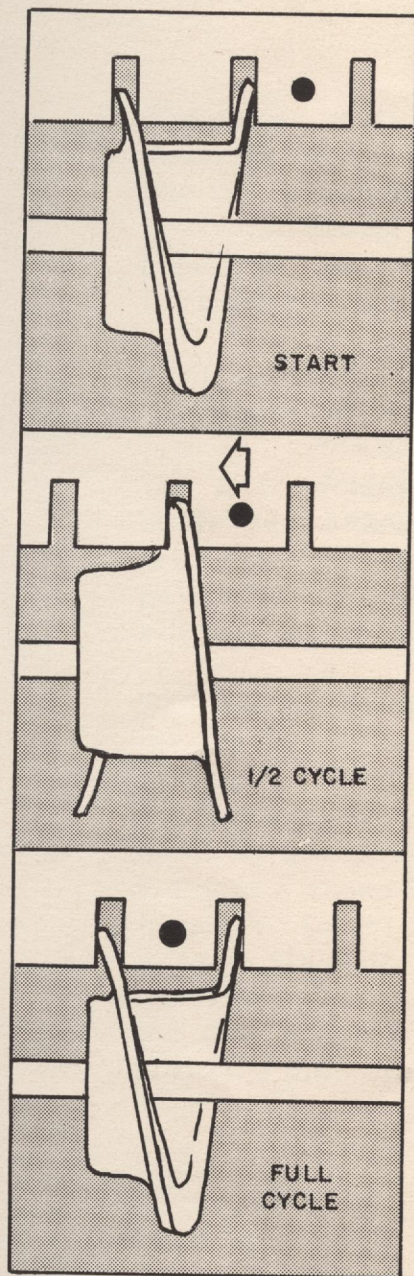
The third method of shifting the carriage of a Monroe Calculator is shown here. A continuous spiral (worm) shaft is used, in the channel of which, a part of the carriage (known as the plunger) is seated. As the shaft turns, the carriage is moved sidewise, one full position (in relation to alignment of carriage gears to base gears) per revolution of the shaft. The worm shaft turns in two directions as indicated. This is used on current production, (C & N) models which you will study later.

WORM SHAFT SHIFT





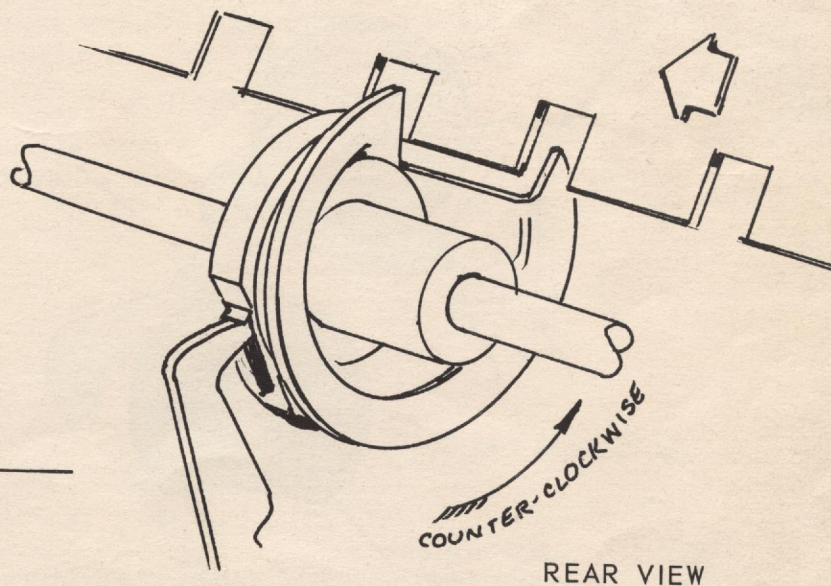
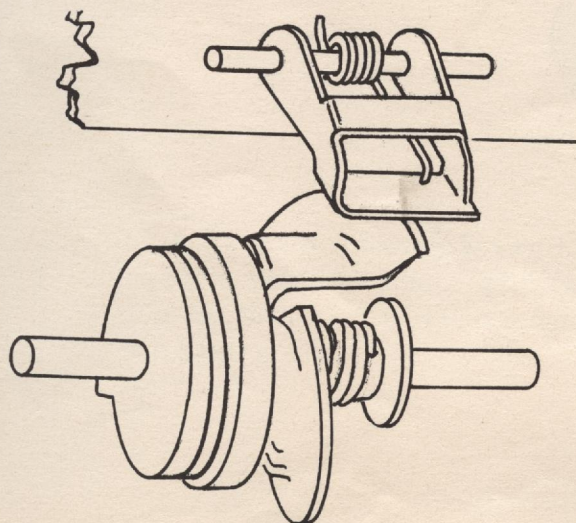
## CARRIAGE SHIFT (CONT'D.)



The MA-7 carriage is moved sideways by a spiral cam pushing against a wall of a slot in the carriage rear rail. This forces the carriage to move a specific distance sideways equal to the width of the spiral cam. At the completion of this shift, a locating plunger, under spring pressure, enters a recess in the front carriage rail. This holds the carriage in alignment with gears of the base.

On the LA-7 it is the pressure of a roller against a wall of a scalloped rail on the front of the carriage that causes the carriage to move sideways.

For purposes of simplicity, our illustration for the rear carriage rail purposely omits the flexible shutters which are designed to yield if the carriage is out of position when the spiral cam revolves. The spiral cam actually contacts the walls of a flexible rear-rail shutter.



REAR VIEW

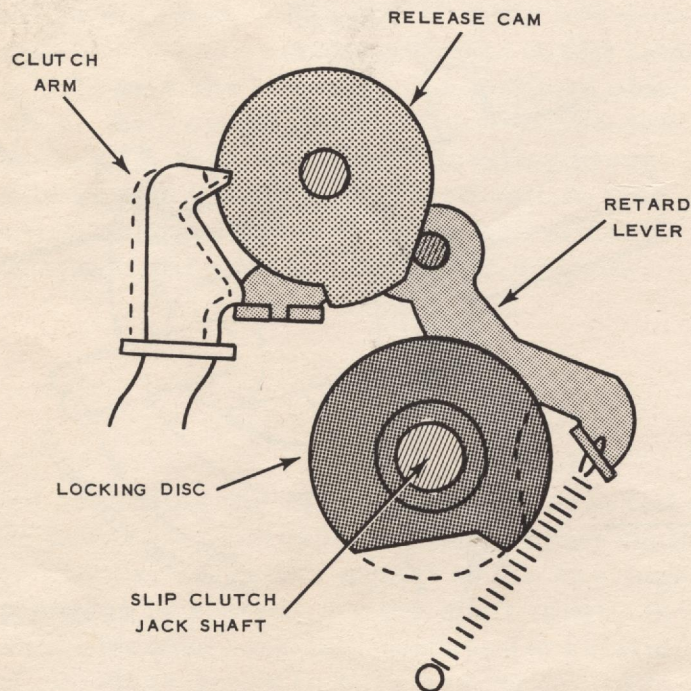


## THE RETARD LEVER

During a L.H. carriage shift, during automatic division, it is necessary that the machine be prevented from neutralizing until the shift is completed. The part known as the retard lever is built into the machine for this purpose.

This lever becomes operative when the clutch arm is withdrawn (moved toward rear of machine) from its engagement with the clutch drum. The lever is rendered inoperative (neutralized) when its release cam engages a lug on the lever and causes it to rock and relatch under a step on the clutch arm. It is shown here in neutral position.

The MA-7 requires this device but the LA-7 does not.





## UPPER DIALS TENS-CARRY

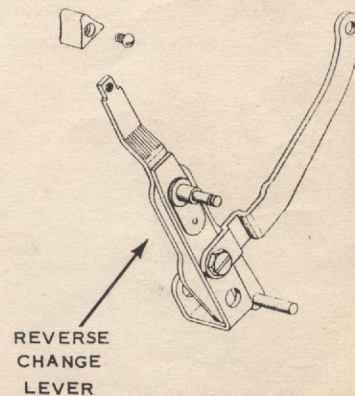
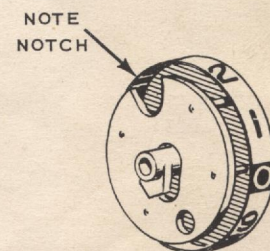
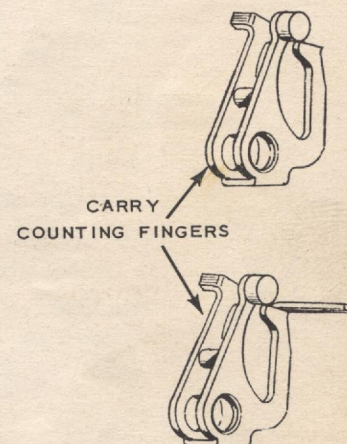
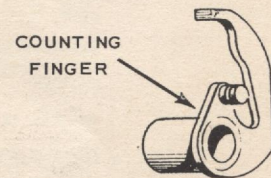
The upper dials (R.H. carrying dials) are driven by a counting finger similar to the way the LA-7 upper dials are operated. There is a big difference in another respect, however; the right hand upper dials of the MA-7 have a carry-over (tens-carry)\* feature. The LA-7 does not have this upper dial feature.

\*The lower (registering) dials employ a different tens-carry method, see Training Book No. 2.

The R.H. counting finger positions its lug between two of the ten teeth of the upper dial, each time the machine is cycled, and causes the dial to be displaced one tooth per cycle. Each tooth represents a digit on the dial perimeter which shows in a window of the carriage cover.

The dial is composed of three main sections; the gear, the dial itself and a control cam. The cam serves the purpose of restraining and preventing the carry fingers (to the left) from operating the dials until required. A notch in the periphery of this cam is provided to permit entry of a round lug on the carry finger when the dial numeral "9" (nine) is being displaced by "0" (zero) and vice versa. When this entry occurs the carry-finger to the immediate left is activated and its lug engages a tooth of the dial above it and causes the two (2) dials to read ten (10) on a plus cycle or "01" on a minus cycle.

A reverse change lever is used in the MA-7. It is not used in the "L" line. The forward or rearward positioning of this lever determines the direction of rotation of the upper dials.

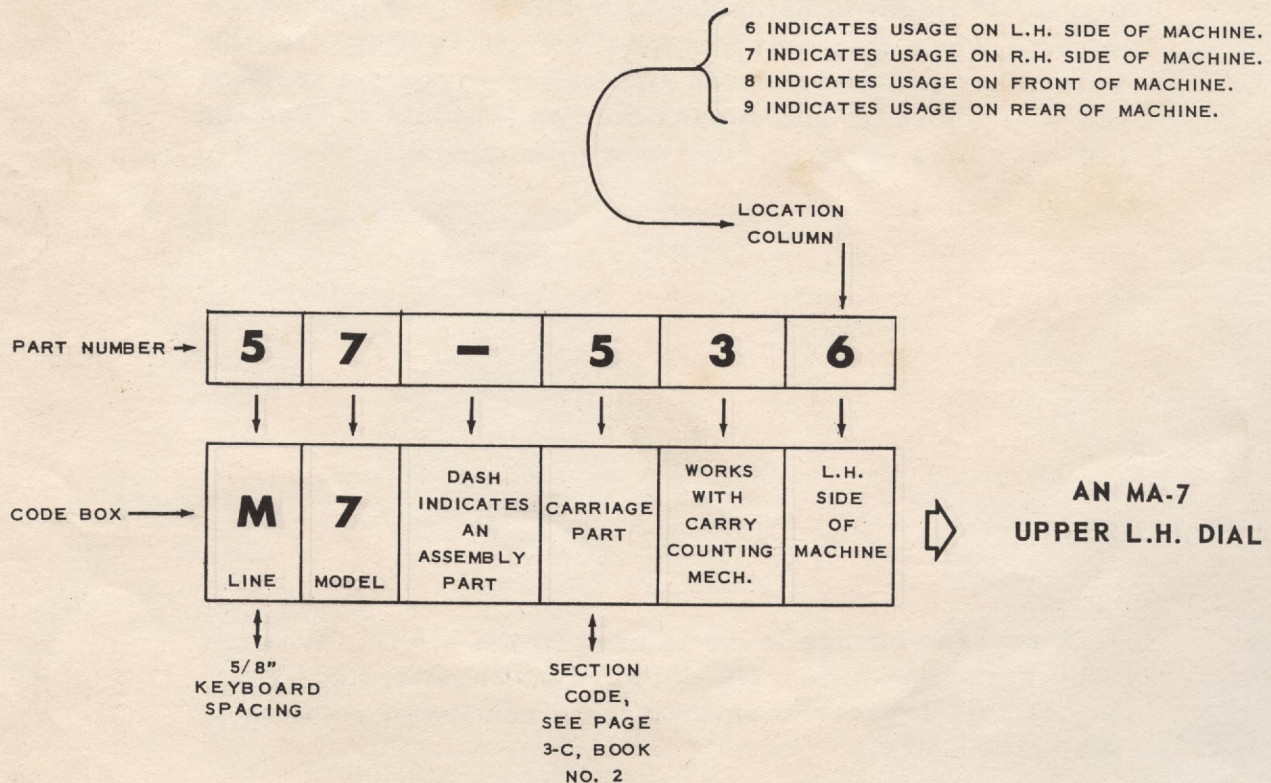




## PART NUMBER CODING

As mentioned in Book #2, the digits and cyphers used in part numbers are meaningful and an understanding of their coding can be of value to servicemen. In addition to the digits and cyphers, prefix and suffix letters are also used, to code many Monroe parts. Part numbers in which a dash (-) appears are known as 'assemblies'. The dash indicates that two or more parts have been joined to form an assembly during manufacture at the factory. Assemblies identified with even-numbered digits (in first position) such as 27-000, 40-000, 41-000, 42-000, 43-000, and 44-000 are used in "L" line machines. Assemblies 30-000, 32-000, 33-000, 34-000, 35-000, 37-000, 50-000, 51-000, 52-000, 53-000, 54-000, 56-000, 57-000, 59-000, and 70-000 are used in the "M" line machines. Note that the first digits of these numbers are odd-numbered. This also indicates that the keyboard keytops are spaced  $5/8$ " apart. The even number, however, tells us that the machine in which a 27-000 assembly is used is of the "L" line and has  $1/2$ " keyboard spacing. Individual parts usage is indicated in the same manner as assemblies, that is, parts with numbers 2000 to 2999 and 40000 to 49999 were originally made for use in "L" line machines, whereas parts 3000 to 3999 and 50000 to 59999 were made for use in "M" line machines.

A sample of assembly part number deciphering is furnished below, using number 57-536 as an example.





## QUESTIONNAIRE

STUDENT \_\_\_\_\_ BRANCH \_\_\_\_\_ DATE \_\_\_\_\_

ORANGE EXAMINER \_\_\_\_\_ RIGHT \_\_\_\_\_ WRONG \_\_\_\_\_

1. Q. The translucent maroon and ivory keytops of the MA-7. W. 3 are spaced further apart, from center to center, than the LA-7 keytops?  
A. RIGHT ☐ WRONG ☐
2. Q. How many (M) models have an individual non-repeat key? Name them.  
A.
3. Q. The four-position change lever serves what main purpose?  
A.
4. Q. What does the '7' in MA-7 represent?  
A.
5. Q. How many tens-carry devices are used in the MA-7. W. 3?  
A.
6. Q. How many complete transmissions are employed in the MA-7. W. 3?  
A.
7. Q. When the keyboard plunger is withdrawn from the front carriage rail, what action is relayed to the clutch yoke?  
A.
8. Q. How many hinge rods are used in the MA-7. W. 3? In the LA-7?  
A.
9. Q. What is a bail?  
A.
10. Q. The ratchet gears for the shift spiral drums always rotate when the motor is running. Why don't the drums rotate without the need of depressing a shift key?  
A.



## QUESTIONNAIRE

11. Q. The rock lever and link on the left side of the LA-7 are driven by a crank arm on the left end of the main carry shaft. What drives the rock lever and link on the MA-7.W.3?
- A.
12. Q. The MA-7.W.3 division lever is held in position by two position-holding arms, an upper arm and a lower arm. What other lever on this model is also held by two (twin) position-holding arms?
- A.
13. Q. Why are the MA-7 R & L Shift keystems made of two parts with a spring connecting them?
- A.
14. Q. Have you reviewed the contents of Calculator Service Bulletin #M-501 which illustrates every part of the MA-7.W.3.s model and shows the relationship to each other?
- A.
15. Q. Will Calculator Service Bulletin #M-501 aid you when assembling or disassembling sections of the machine?
- A.
16. Q. Located below the sun pinion gear there is a spring loaded cam. What is its purpose?
- A.
17. Q. Does the carriage raise when the lower dial clear key is depressed?
- A.
18. Q. What raises the carriage at that time?
- A.
19. Q. Are both sections of the carriage hinge rod of the same length?
- A.



## QUESTIONNAIRE

STUDENT \_\_\_\_\_

20. Q. Is there a difference in the design of the MA-7.W clutch yoke engaging arms and the LA-7 yoke arms? If so, what?
- A.
21. Q. Did you know that there are many valuable service bulletins available in your Branch that cover mechanisms of the many "M" models? Have you looked through the Branch library of service bulletins, manuals, catalogs, etc.
- A.
22. Q. On the wedge shaft, alongside of the intermediate gears, there is a part that slides rearward from engagement with the selecting gears. What is the purpose of this part?
- A.
23. Q. Why are flexible shutters used on the rear rail of the carriage?
- A.
24. Q. Above and behind the circular, hand crank plate on the R.H. side of the machine (below the plus bar), there is a toggle assembly. What is its purpose?
- A.
25. Q. Carefully look over the carry-counting fingers unit. Now ask your instructor to show you Machine Service Bulletin #203. After carefully reading the bulletin and reviewing it with your instructor, do you understand how the carry-counting fingers are adjusted?
- A.
26. Q. Should persons, other than servicemen, unlatch the carriage locks and raise the carriage?
- A.
27. Q. Why?
- A.



## QUESTIONNAIRE

28. Q. Why should the four, tie-blanks (couplers) on the wedge shaft be snug fitting?
- A.
29. Q. From looking at the keyboard (only) how can you tell the MA-7. W keyboard from the LA-7?
- A.
30. Q. Why are cross-locks used in the MA-7. W?
- A.
31. Q. What model was machine part #3026 originally made for, "L" or "M"?
- A.
32. Q. How do you know?
- A.
33. Q. What does the numeral "3" represent, as in MA-7.213?
- A.
34. Q. What does the letter "A" mean after the M in "MA-7".
- A.
35. Q. What does the numeral "6" stand for in the model designation MA-6?
- A.
36. Q. In what operational way does the MA-7. W.3 differ from the MA-7?
- A.
37. Q. With carriage removed from the machine, the plus and minus keys cannot be depressed? Why?
- A.
38. Q. The carriage hinge rods have keyways cut into them whereas the LA-7 does not. What purpose does the keyway serve?
- A.

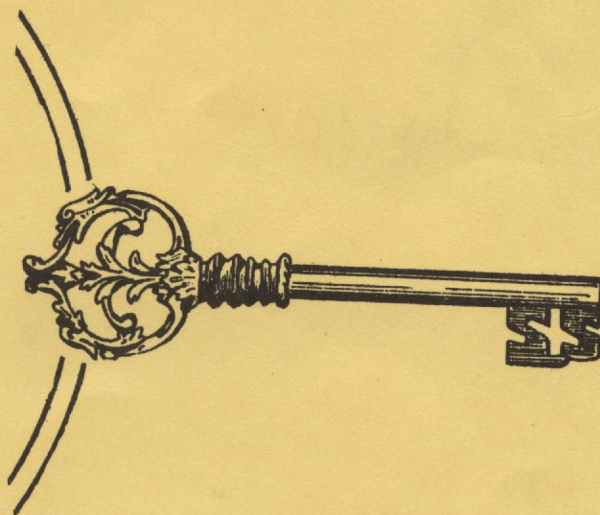


## QUESTIONNAIRE

STUDENT \_\_\_\_\_

39. Q. Two shift limiting bumper studs are used in the lower rear section of the carriage. They are adjustable. Why?
- A.
40. Q. The Monroe Calculator generally speaking, is composed of (A) the carriage and its internal parts, (B) the carriage dials actuating devices within the base of the machine, (C) the keyboard and the selecting mechanism which functions when a keyboard numeral key is depressed, (D) the carriage shifting mechanism, (E) the cycle control mechanism, (F) the planetary transmission, (G) the cross-locking mechanism, (H) the driving devices (motor unit and gear trains). Which of these have you received instruction on and thoroughly understand? Check the identifying letter of such items with a pencil or pen.
- A.

- A key to learning is concentration.
- A key to understanding: "First obtain a general impression of the whole job. Then concentrate on the units and details."
- To be really expert at anything there is a need for constant practice.





# EXERCISES

STUDENT NAME: \_\_\_\_\_

1. Two shift locking bumper studs are used in the lower rear section of the carriage. They are adjustable. Why?

2. The Monitor Calculator generally speaking, is composed of (A) the carriage and its internal parts, (B) the carriage data actuating device within the base of the machine, (C) the keyboard and its feeding mechanism which functions when a keyboard numeral key is depressed, (D) the carriage shifting mechanism, (E) the cross-locking mechanism, (F) the planetary transmission, (G) the cross-locking mechanism, (H) the driving device (motor and gear train). Which of these have you received instruction on and thoroughly understand? Check the identifying letter of each item with a pencil or pen.

3. Two types of keys are used in the Monitor Calculator. What are they?

4. The "A" key is known as the "A" key. What is its function?

5. A key is known as a "function" key. What is its function?

6. A key is known as a "function" key. What is its function?

7. A key is known as a "function" key. What is its function?



## MA 7-W-3-s ADJUSTING SEQUENCE

1. 100 Section (Keyboard)
2. 200 Section (Selector Mechanism)
3. 300 Section (Intermediate Gear Section)
4. 400 Section (Carry-over Section)
5. 500 Section (Carriage)
  - a. Align the carriage for straightness. (Use Kit Tool #151 -fixture)
  - b. Adjust the carriage to the body (base) of the machine.
  - c. Adjust the carry-counting fingers in relationship to the carriage.
6. Left Side tripping adjusting sequence.
7. MA-7 clutch yoke adjusting sequence.
8. Plus and minus functions.
9. Functional adjusting sequence of the lower and upper dial clearing mechanism.
10. Functional adjustments of the shift mechanism including automatic division shift.
11. Plunger-lock function and adjustments.
12. Retard latch function and adjustments.
13. Automatic division functions.
14. Division slide adjustments.
15. Automatic control of change lever and non-repeat.

It should be borne in mind that in adjusting any machines absolutely NO BINDS are permitted. Adjustments and springs used to perform certain functions, are not for the purpose of overcoming binds, but for the sole purpose of securing correct machine operations. The definition of minimum clearance is the least clearance necessary to permit free movement of any components without friction being set up due to binds or interference.







## KEYBOARD

The main function of the keyboard, as explained in Book No. 2 is to permit selection of a number which at the completion of a revolution of the machine will appear in the lower (registering) dials.

When any numeral keys are depressed the camming surface of the keystem moves the keystem locking shutter bail to the left and finally the shutter bail moves into the keystem opening (notch) and locks the keystem in its "down" position. Each shutter bail controls one vertical row (bank) of numeral keys. If an operator error is made by depressing a wrong key, another key may be depressed in the same row. This will permit the previously depressed key to be automatically released during the depression of the correct key.

To accomplish the above it is necessary that the shutter bails be parallel to each individual row of keystems. The shutter bails can be realigned (straightened) to obtain this condition. Block one end of the bail with a screwdriver and move the other end in the opposite direction with another screwdriver.

See page 1-H of Book No. 2 for function explanation of the internal parts of the of the keyboard. Ignore the zerokey bail shown. It is for "L" line only.

### KEYBOARD CLEAR KEY

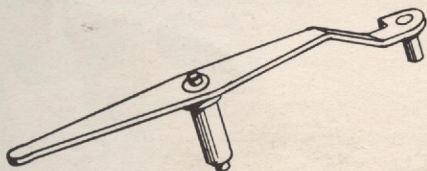
1. Adjust the stop limit washer on the guide bracket for the zero clear keystem to permit the zero clear keytop to be of the same height as the upper and lower clear keytops.
2. With the zero clear key held fully depressed, adjust the right and left clamped arms on the zero master clear shaft to permit the shutter bails to move into the upper opening of the zero keystems.

For individual adjustments re-form the lower prongs of the zero keystems to meet the master clear shaft.

### KEYBOARD LOCK LEVER

The keyboard lock lever serves to lock the shutter bails locking bar during any machine cycling while the selector gears are in mesh with the intermediate gears. This prevents depression of numeral keys during the cycling.

### ADJUSTMENTS



1. (With machine mechanism in Neutral) Reform the rear extension of the lock lever to permit the stud to have minimum clearance with respect to the cut out portion of the locking cam on the selector gear shaft, when any numeral keys are depressed.
2. (With machine mechanism positioned halfway through a cycle) Reform the same rear extension of the lock lever to permit the stud to have light contact with the side of the lock cam.

NOTE: If a keyboard has been removed from the base of the machine, it is important when reinstalling the keyboard, before the screws are tightened, that the keyboard be pushed rearward and down.

It will later be apparent that we otherwise may have trouble with keyboard clear when using non-repeat. Also, the relationship of the keyboard shift plunger to the carriage front rail may be altered.



## SELECTOR MECHANISM

### SELECTOR BAILS and SELECTOR GEARS

1. Adjust the knurled screw cap located against the left end of the selector gear shaft for minimum end play of the shaft. This knurled screw cap is held in a fixed position by a friction washer.
2. (Zeros positioned "up" on the keyboard)  
Cycle the machine manually until number one tooth of the four tooth selector gears and the teeth of the five tooth selector gears straddle the intermediate gears. Adjust the upright prongs for the four tooth gears to pass the teeth of the intermediate gears with a safe clearance. In the same position adjust the prongs for the five tooth selector gears to permit their teeth to pass the spring lifters with safe clearance.

NOTE: It is important that both uprights of the selector bails contact the selector gears equally; if this does not occur the following conditions may be encountered.

- a. Incorrect selections.
  - b. Heavy key depression.
  - c. The numerical key may not restore when the non-repeat key is used due to a leaning of the selector gears on the selector shaft, this would be most apparent when number 4, 5, 6, 7, 8, and 9 were depressed.
3. With numeral keys from 1 to 9's depressed and the machine cycled manually, adjust the individual lugs on the selector bails to permit 2/3 engagement of the desired teeth of the selector gears with the intermediate gears (Use Kit Tool #121).

### INTERMEDIATE GEAR SECTION

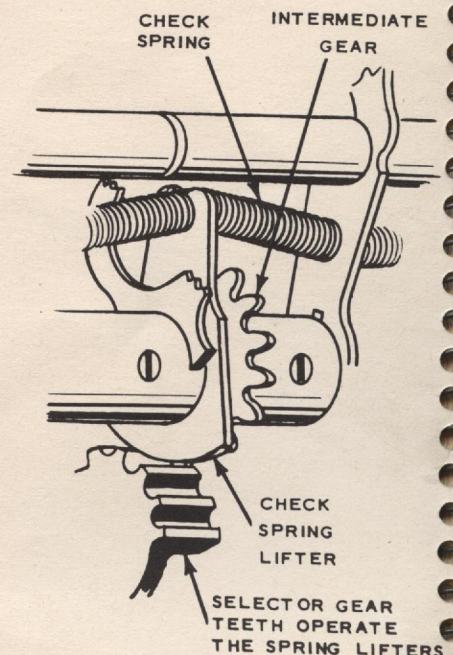
The function of this major unit is to transmit the selected number of teeth displacements into the lower dials in the carriage via the unit and carriage intermediate gears; also to provide for a carry-over function in conjunction with the carry-over shaft. (Main carry shaft).

The function of the spring lifters is to push the checkrollers spring rearward, away from the teeth of the intermediate gears during any selection except zeros and ones. The teeth of the selector gears operate the spring lifters. The purpose of the spring lifters is to eliminate wear of the check spring and also to reduce mechanical noise.

### ADJUSTMENTS

1. Adjust the braces #2391 by reforming, to hold the upper and lower shafts parallel.
2. Adjust the horizontal and the vertical braces to support the upper and lower shafts without exerting any pressure against the shafts.
3. The check spring should check all the intermediate gears and be stretched only far enough to separate the spring coils. Damaged springs must be replaced.
4. Carry-over wedge spring (See Sketch)
5. Adjust the adjustable collars for the carry-over wedge springs to equalize the movement of the carry-over wedges down and up after passing the imaginary "dead center" line.

NOTE: (10 bank machines) The extreme right hand collar for the intermediate gears should be adjusted so as not to interfere with the movement of the right hand carriage lock assembly.





## CARRY-OVER SECTION

The function of this section is to transmit a one tooth displacement into the lower dial immediately to the left (viewed from the front) of any depressed carry-over wedge. A wedge is positioned downward by the pin on a carriage intermediate gear, either in a plus or minus rotation depending on the activation of the plus or minus dog.

The carry-over shaft rotates on two self-aligning bearings and can be adjusted sidewise by means of a bracket on the center cross-brace of the machine.

### ADJUSTMENTS:

With a carry-over wedge in its "downward" position, cycle the machine until the curved surface of the carry-over wedge is holding the carry-over dog in its maximum rocked position. Adjust the shaft sidewise until this dog has a full sidewise hold with the intermediate gear.

**NOTE:** If the intermediate gear does not displace a full tooth it is permissible to favor the shaft toward the right to permit a 3/4 hold thereby increasing the pivoted height to which the wedge raises the dog.

## CARRY COUNTING FINGER SECTION

The function of this section (which is between the wedge shaft & upper dials) is to operate an upper dial or dials on each machine cycle.

After the carriage has been correctly adjusted to the base of the machine, the carry counting finger section is adjusted to the carriage.

### ADJUSTING SEQUENCE

1. Check the two camming shafts in this section for straightness.
2. Check #1 counting finger to be at a 90° angle to pivot flange.
3. (Machine in Neutral.) There should be a minimum clearance between the carrying fingers and the upper shaft. If necessary, reform the fingers toward the shaft with parallel pliers.
4. Install the carriage and fully seat it. Check #1 counting finger to have a full hold on the upper dial gears when manually cycling the machine. If adjustment is required, loosen the two end bushings and shift the whole carry counting section endwise to obtain the correct adjustment; allow minimum end play for freedom from binds.
5. (Carriage off). Install Kit Tool #93 on the carry counting finger section, its right edge to meet #1 counting finger. Form the carry fingers and studs to line up with the edges of the jig openings. Install the carriage and double check this adjustment as there may be a slight variation in the spacing of the upper dials. The fingers and studs must have a full flush sidewise hold on the dial teeth and the carry-over cams; refine this adjustment if necessary.
6. (Carriage off). Cycle the machine until the carry counting fingers are in a vertical position. With the #93 jig installed, adjust the carry-over tails by reforming to permit the studs to meet the jig (keep the tails as close to the heel of the carry fingers as possible.) This adjustment must be started from the right and worked toward the left.

**NOTE:** The #93 jig should be checked for .050" over-all taper before making the above adjustment. This can be checked by laying the jig on a straight plane. The left end should be raised .050". Adjust the left bracket of the jig if necessary.



## CARRY COUNTING FINGER SECTION

The result, after #6 adjustment is made, will be .005" taper between each carry counting finger, preventing over-carries not called for.

7. With the machine cycling at its proper speed (630 to 650 cycles per minute) adjust the carry counting fingers friction setting, by the adjustable nuts and lock nuts. The compression springs must permit the carry counting fingers to lay as low as possible after each plus or minus cycle. It will be noted if the change lever is left in one position there will be a little difference in the position of the fingers in plus and minus. This is due to a lag from the change lever clutch assembly and also from the drive gears offset to the carry counting finger section.

NOTE: Incorrect counting finger springs may give trouble in this section.

## THE CARRIAGE

It is important that the carriage be checked for perfect straightness and alignment before setting and adjusting it to the body (base) of the machine.

### CARRIAGE ALIGNMENT

1. Check the front lock ledge and the back rail for straightness with a straight edge.
2. Check the shift shutters for equal spacing between each shutter.
3. Check the carriage hinge rod brackets for straight alignment using aligning rod (Kit Tool #102). If the double end brackets do not line up they can be straightened into alignment with respect to the center bracket using Kit Tool #102.
4. With the aligning rod in location through all carriage brackets, place the carriage on the carriage aligning jig (Kit Tool #151). Hold the aligning rod against the two rear supports, under this condition apply pressure on the left and right front of the carriage, all four points should be resting on the jig at the same time. If clearance is observed at one end or the other of the front portion of the carriage, remove the carriage back rail and make sure it is straight. Remove stock from the proper bracket to allow a straight edge to rest on all three brackets evenly. Replace the back rail and tighten the screws, place the carriage on #151 jig again. All four points must meet the jig at the same time.

The carriage is now ready to be set to the body of the machine.

### CARRIAGE ADJUSTING SEQUENCE

1. Adjust the trip lever prong point to centrally locate in relation to the uppermost tooth on the wedge shaft spool gear. This is similar to the "L" model setting.
2. Adjust the plunger bracket on the keyboard to obtain two conditions.
  - a. With the carriage fully seated on its support arms, if necessary, shim the bracket up or down to permit .010" clearance between the scallop ceiling and the top of the plunger.
  - b. Adjust the bracket sideways for perfect sideways mesh of the wedge shaft intermediate gears and the carriage intermediate gears.



## THE CARRIAGE (CONT'D.)

3. With 9's and 0's alternately in the lower dials, adjust the left hinge rod bracket forward or rearward to obtain equal clearance between the carry-over pins and the trip lever prong point.
4. Adjust the right hinge rod bracket forward or rearward so that when the carriage is slightly raised for shifting an equalized space can be sighted between the wedge shaft intermediate and the carriage gears.
5. (Remove the carriage). Adjust the two inner carriage hinge rod brackets to align with the outside brackets. Use the aligning rod for this checking. The aligning rod must slide freely through all four brackets.
6. Lower the left and right carriage front rests (support arms) to permit as deep a mesh as possible between the intermediate and the carriage gears. Raise the carriage support arms just far enough to prevent the carry-over pins from rubbing the carry-over wedges when 0's or 9's are in the lower dials.

NOTE: The carriage must rest on the support arms. They should be locked in place after the adjustment.

7. Adjust the right hand shift drum by its clamp to permit the retard latch cam to have a full hold on the #2 retard latch offset (See retard latch adjustments).
8. With the carriage fully seated in any carriage position except the first, adjust the carriage back rail, sidewise, to permit the starting spiral of the right shift drum to enter evenly between two shift shutters.
9. Adjust the left shift drum sidewise to permit its starting spiral to enter evenly between two shift shutters.

NOTE: If adjustments #8 and #9 are set correctly, when alternately rotating the shift drums manually there should be an equal location of the shift plunger in relation to the scallops on the lock ledge at the completion of each manual shift.

10. Shift the carriage first to its extreme left and then its extreme right positions. Adjust the carriage limit stops to permit the shift plunger to enter freely into the center of the scallop.

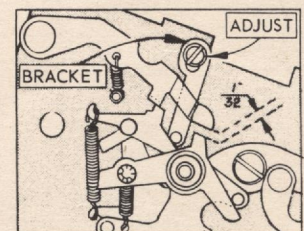
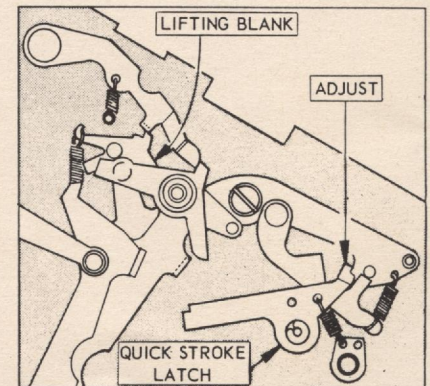
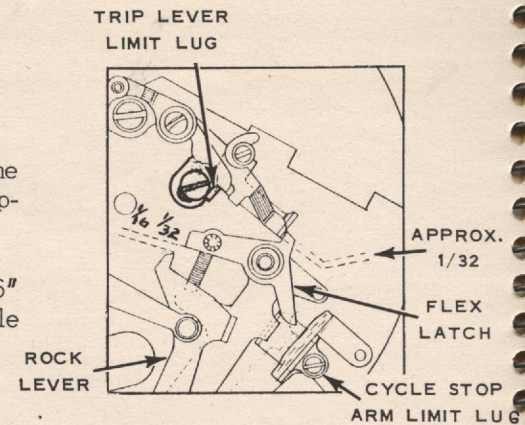
NOTE: Set the right limit stop with the flat surface toward the upper dial clear drum.

11. Adjust the carriage cover by means of the limit stops located on the carriage end plates to permit the dial numbers to center in the windows.
12. (Machine halfway through a machine cycle). Adjust the carriage locks to get two conditions.
  - a. Adjust the lug on the carriage locks at right angle ( $90^\circ$ ) against the scallop ledge to give minimum clearance between the cam engaging surface of the carriage lock assembly and the locking cams on the selector gear shaft.
13. With the carriage fully seated and the machine in a  $1/2$  cycle rotate a carriage intermediate gear until its carry-over pin rests on top of the trip lever point. Adjust the trip lever by its set screw, to raise the forward end of the trip lever  $1/32''$  above the flexible latch on the cycle stopping arm.



## LEFT SIDE TRIPPING ADJUSTING SEQUENCE

1. Adjust the trip levers limit lug to permit  $1/32''$  depth of hold of the forward end of the trip lever on the flexible latch of the cycle stopping arm.
2. Adjust the cycle stopping arm limit lug to permit  $1/32''$  to  $1/16''$  horizontal passing clearance between the flexible latch on the cycle stopping arm and the machine rock lever.
3. Slowly depress the plus or minus key. Reform the forward offset of the quick stroke latch so that it moves under the step on the stopping lever assembly at the same time that the lifting blank drops under the offset on the flexible end of the trip lever. (See Sketch #2).
4. (Machine in Neutral) Rotate the quick stroke latch; form the rear offset of the quick stroke latch to have a minimum clearance when passing over the peak of the sub-latch of the stopping lever.
5. Adjust the stop bracket stud against the lifting blank to cause the forward end of the flexible end of the trip lever to rise  $1/32''$  above the flexible latch of the cycle stopping arm as the stopping lever assembly is manually moved up and down. (See Sketch #3)

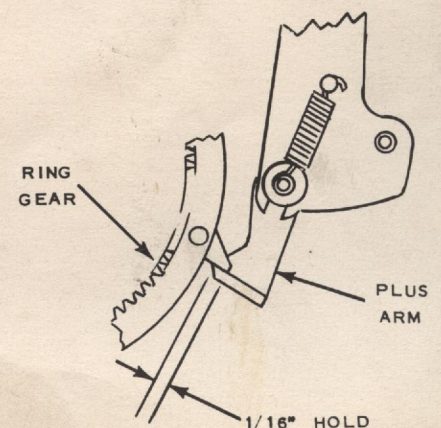
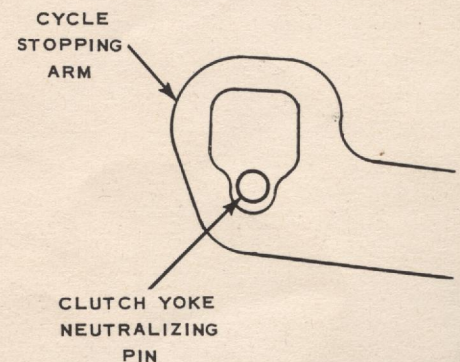


## NINE POINT CLUTCH YOKE ADJUSTING SEQUENCE

1. Manual neutral
2. Clutch yoke click
3. Plus arm
4. Minus arm
5. Contact closing arm
6. Automatic clutch yoke position holding arm
7. Clutch yoke blank
8. Balance the clutch yoke tail
9. Automatic neutral.

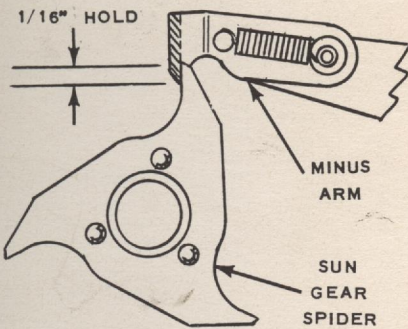
### ADJUSTMENTS

1. Manual neutral: With the cycle stopping arm held against the bumper pad, adjust the rear extension of the cycle stopping arm by forming upward or downward to locate the clutch yoke neutralizing pin as shown in the sketch.
2. Clutch yoke position holding arm: With the cycle stopping arm held against the bumper pad adjust the clutch yoke holding arm at its eccentric, hexagon pivot point to locate in the neutral (center) notch. Check for equal slight movement when moving the clutch yoke toward the plus and minus directions both.
3. Plus: With the clutch yoke holding arm in the plus notch, adjust the link connecting the clutch yoke to the plus and minus claws to cause the plus offset to engage a lug on the ring gear with a  $1/16''$  hold.



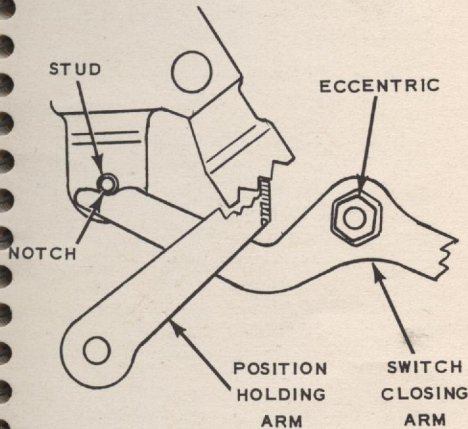


## NINE POINT CLUTCH YOKE ADJUSTING SEQUENCE (CONT'D.)

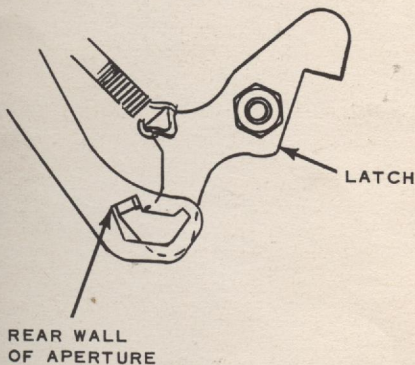


4. Minus: With the clutch yoke position holding arm in the minus notch, form the minus arm (not the offset) to cause a 3/4 hold of the minus offset with the sun gear lug.

NOTE: New style clutch yokes should be adjusted to have a 1/16" engagement of their offsets with the transmission.

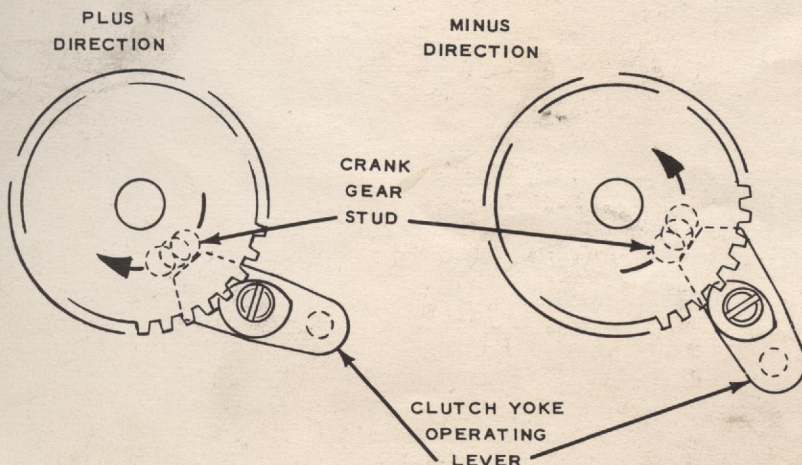


5. Contact closing arm: With the clutch yoke position holding arm (click) held in the neutral notch of the clutch yoke, adjust the eccentric hexagon for the switch closing arm to permit the notch (dwell) to locate centrally in relation to the switch operating stud on the clutch yoke.



6. Automatic Clutch yoke positioner: Slowly position the division lever rearward. When the pin of the division lever is positioned on the lowest point of the triangular flipper of the clutch yoke rocker assembly, adjust the eccentric stud to position the automatic latch against the rear wall of the aperture and halfway between the upper and lower walls of the aperture.

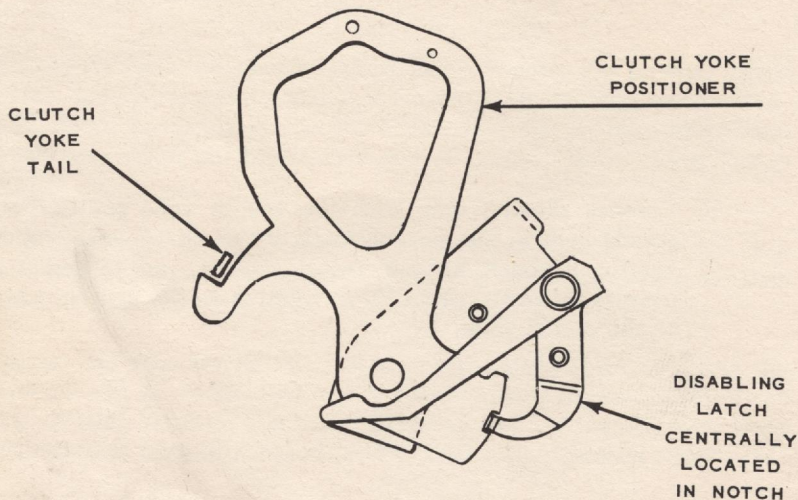
7. Clutch yoke operating lever: With the division lever rearward adjust the hexagon pivot nut (through its elongation in the left side frame). Adjust so that the clutch yoke operating lever will position the clutch yoke equally into plus and minus from neutral. This should occur when the operating stud on the crank gear moves the clutch yoke lever during the return of the cycle stopping arm from bumper strokes during automatic division.



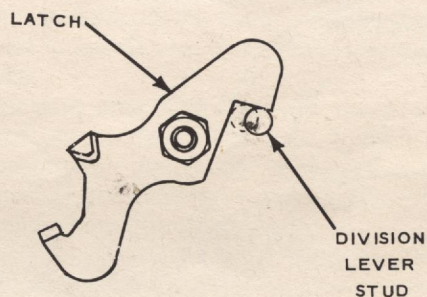


## NINE POINT CLUTCH YOKE ADJUSTING SEQUENCE (CONT'D)

8. Clutch yoke tail: Machine in neutral; adjust the square block on the plus and minus rocker shaft to locate the disabling latch centrally in the notch on the clutch yoke positioner. With the plus and minus keys alternately fully depressed, adjust the clutch yoke tail to move the clutch yoke into plus and minus equally.



9. Automatic + neutral: Position the division lever to the rear, then toward the front of the machine. The pin on the division lever is now locked in the path of the automatic latch of the clutch yoke extension. Cycle the machine off-center far enough to permit the operating stud on the crank gear to be out of the path of the clutch yoke operating lever. Slowly move the plus arm offset of the clutch yoke into engagement with a lug on the transmission ring gear. When the plus offset has 1/2 of its hold (3/8 engagement) the automatic latch should normalize. If this condition is not correct adjust the eccentric hexagon for the division lever positioner. This positions the division lever pin further toward the rear of the machine. It can also position the pin further toward the front. Rearward adjustment of the pin will normalize the automatic latch sooner. A forward adjustment will delay the release of the latch.





## PLUS and MINUS FUNCTION

### PLUS FUNCTION: (Repeat Key down)

1. Plus key depressed.
2. The plus and minus rocker shaft pivot
3. The disabling latch rocks the clutch yoke positioner. The triangular aperture of the positioner lever operates the roller on the rear extension of the stopping lever assembly, when this assembly is operated, the lifting blank drops under the offset of the trip lever flexible end at the same time that the forward offset on the quick stroke latch locates beneath the step of the stopping lever assembly.
4. The yoke positioner's plus lug operates the clutch yoke tail. As the clutch yoke is in the process of moving into plus, the stud on the clutch yoke operates the switch closing arm lowering the locator arm out of the path of the offset on the machine rocker arm. The contact points close, starting the motor. Finally, the clutch yoke plus arm offset moves into engagement with one of the lugs on the ring gear causing the machine cycle to start.
5. During the first one-half machine cycle the machine rocker arm operates the quick stroke latch and the rear offset of the quick stroke latch moves across the top of the sublatch building up spring tension for the forward end of the stopping lever assembly. As long as the plus key is held depressed the stopping assembly will not be normalized, therefore the machine will continue to cycle.
6. When the plus key is released, the built up spring tension against the stopping lever assembly raises the lifting blank, this in turn raises the flexible end of the trip lever above the flexible latch on the cycle stopping arm thereby permitting this latch to drop into the path of the hook on the machine rocker arm. As a result the cycle stopping arm is driven against the bumper pad and the aperture of the cycle stopping arm locates the clutch yoke neutralizing pin thus moving the clutch yoke into its neutral position. As the spring on the cycle stopping arm pulls the cycle stopping arm away from the bumper pad, the locator arm raises into the path of the offset on the machine rocker arm and the switch closing arm is normalized permitting the contact points to open and stop the motor.

### MINUS FUNCTION:

The minus function is exactly the same as plus with the one exception that the minus clutch yoke arm offset engages a lug on the sunspider thereby reversing the direction of the machine cycle.

### PLUS OR MINUS FUNCTION WITH NON-REPEAT KEY DOWN:

The functions are the same as previously explained with the exception that the movement of the lower portion of the keyboard clearing lever is blocked. Therefore, near the completion of one machine cycle (after a full set of nines on the keyboard have been entered in the lower dials) the floating cam operated by the driving gear contacts the keyboard release lever moving it against the keyboard clearing bell crank. This in turn operates the keyboard master clearing bar moving the keyboard shutter bails out of the notches of the keystems, thus permitting these keystems to clear.

NOTE: This last function is the main reason for positioning the keyboard to the rear before tightening the keyboard anchor screws.



## PLUS and MINUS FUNCTION (CONT'D.)

### MINUS FUNCTION:

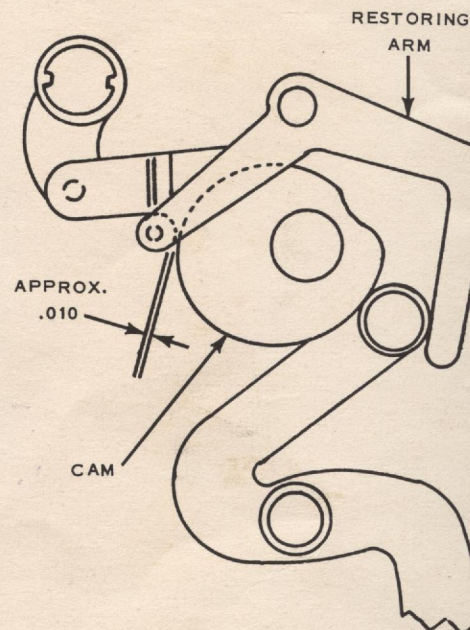
(Lower dials cleared to zeros and a numeral key depressed in the right hand column). As the minus key is depressed the function is basically the same as previously explained. As the right lower dial moves from zero to nine the carry-over pin on the carriage gear depresses #1 carry-over wedge. The lower portion of the carry-over wedge is now in the path of #1 minus carry-over dog. As the #1 minus carry-over dog is pivoted when contacting the carry-over wedge, the left end of the carry-over dog moves up between two teeth of the intermediate gear to the left, displacing it, one tooth. The #2 dial then moves from zero to nine, the carry-over pin on the second carriage gear depresses #2 carry-over wedge.

The same sequence is continued to the left until a carry-over pin operates the trip lever prong point. The forward end of the trip lever is raised above the flexible latch on the cycle stopping arm and the cycle stopping arm is driven to the bumper pad thereby neutralizing the clutch yoke. A stud on an arm driven by the cycle stopping arm operates the disabling latch thus uncoupling it from the notch in the clutch yoke positioner, permitting the yoke positioner to normalize through its spring tension. When the minus key is released, the plus and minus rocker shaft will normalize and the disabling latch will again locate in the notch of the clutch yoke positioner.

### UPPER DIAL CLEARING MECHANISM

#### ADJUSTING SEQUENCE:

1. Machine in Neutral: Adjust the nuts on the upper dial clearing pull rod to permit the clutch arm to be fully seated in the clutch drum opening. This must assure immediate movement of the clutch arm when the dial clear key is depressed.
2. With the clutch arm in the opening above the clear drum's clutch pawl, check the adjustment for the switch points to close. (Refine this adjustment if necessary).
3. Manually, cycle the upper dials clearing drum halfway through a clearing cycle. Adjust the clearing drive lever, by loosening the two screws and nuts, to cause the dial clear fingers to fully clear the upper dials to zeros without cramping.
4. Manually continue the clearing drum's cycle until the restoring arm's roller contacts the cam at its highest point (See Sketch). Adjust the restoring arm's extension by reforming it to permit about .010" clearance between the return drive roller and the cam.



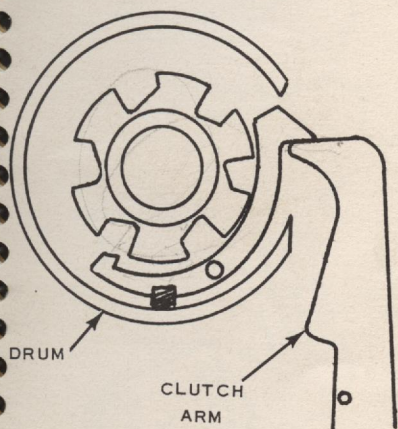


## UPPER DIAL CLEARING MECHANISM (CONT'D.)

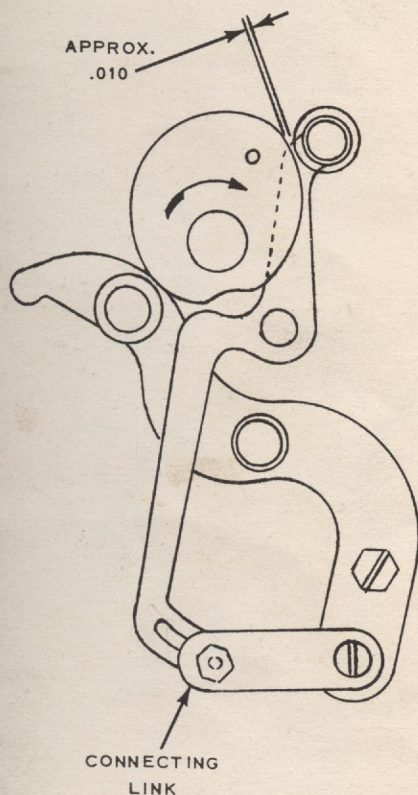
5. Restore the clearing drum to normal under power. Adjust the eccentric stud on the carriage right end plate to clear the square shaft's clear linkage by about .010".
6. Under power, quick stroke the upper dials clearing key. Adjust the friction brake to permit only one clear cycle per each quick stroking.

## LOWER DIAL CLEARING MECHANISM

### ADJUSTING SEQUENCE:



1. Machine in Neutral: Adjust the nuts on the lower dials clearing pull rod to permit the clutch arm to be fully seated in the drum opening, this must assure immediate movement of the clutch arm as the clearing key is depressed.



2. Machine in Neutral: Adjust the connecting link to create about .010" clearance between the return drive roller and the drive cam.
3. With the lower dial clutch arm in the opening above the clear drum's clutch pawl, adjust the set screw against the blank operated from the lower left end of the universal bail to close the switch points.
4. Cycle the lower dials clearing drum manually halfway through a clear cycle and make two adjustments.
  - a. Adjust the carriage raising arm by loosening the large hexagon screw and set the raising arm through its elongation to raise the carriage gears high enough to rotate with about .030" clearance above the intermediate gears.
  - b. Adjust the lower dials clearing drive lever, by loosening its two screws and nuts, to cause the dial clear fingers to fully clear the lower dials to zeros without cramping.
5. Restore the clear drum to normal under power. Adjust the limit lug on the carriage left end plate to clear the square shafts clearing linkage by about .010".
6. Under Power: Quick stroke the lower dial clearing key. Adjust the friction brake on the clearing drum to permit, only one clear cycle per each quick stroking.



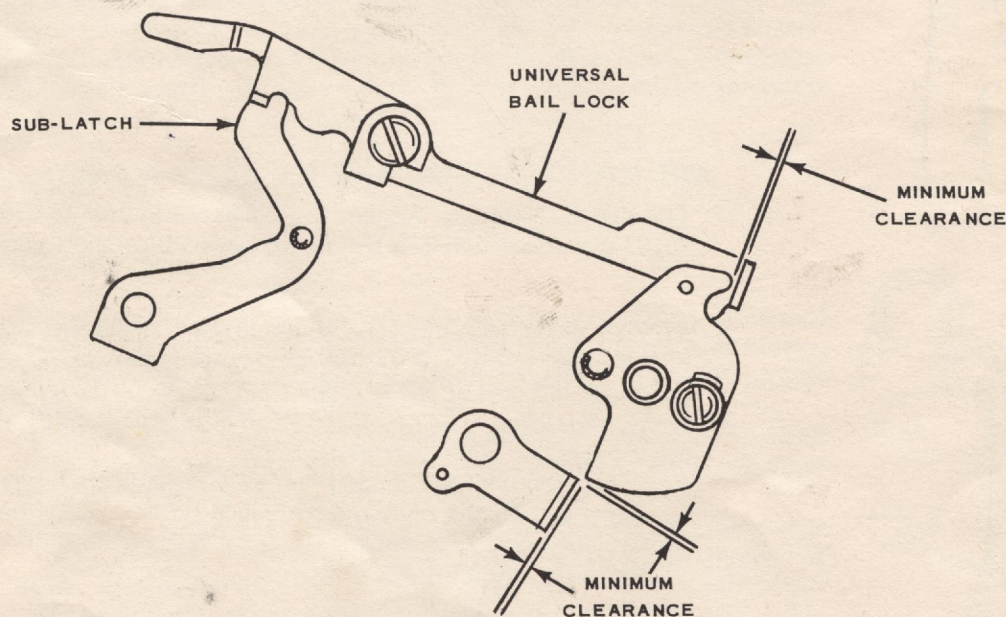
## SHIFT MECHANISM ADJUSTING SEQUENCE

### AUTOMATIC DIVISION SHIFT

NOTE: Disconnect the two linkages fastened to the lower ends of the clutch arms for the shift drums.

#### ADJUSTMENTS:

1. Machine in Neutral: With the universal bail lock resting on the step of the sublatch, set the adjustable plate on the universal bail to obtain two conditions, (a) and (b).
  - a. To clear the universal bail lock with minimum passing clearance.
  - b. Vertical Clearance: Set at closest possible passing clearance between the adjusting blank and the switch lock lug on the forward end of the switch closing arm.  
Adjust the switch lock lug up or down to create minimum horizontal passing clearance.



The function of the universal bail lock is to lock the universal bail during automatic divisions.

The function of the switch closing lock is to lock the universal bail during plus and minus functions.

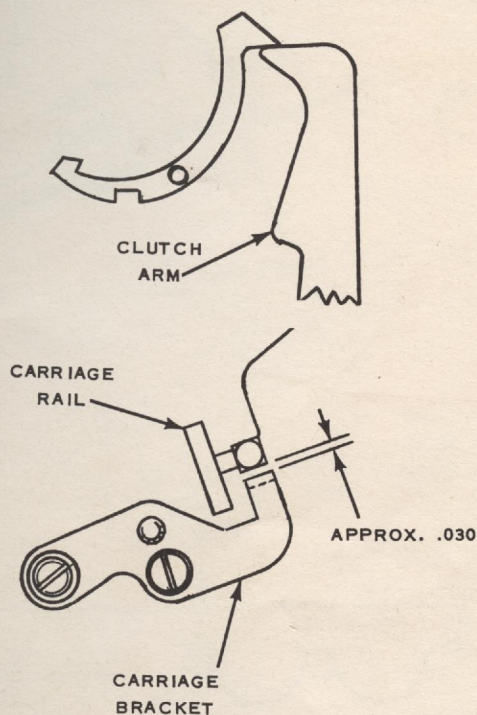
2. Lightly depress the left and right shift keys. Adjust the set screws on the driving arms connected through linkage to the universal bail, to permit slight clearance between the steps of the shift keystems and the top guide plate before resistance to the key depression is encountered.



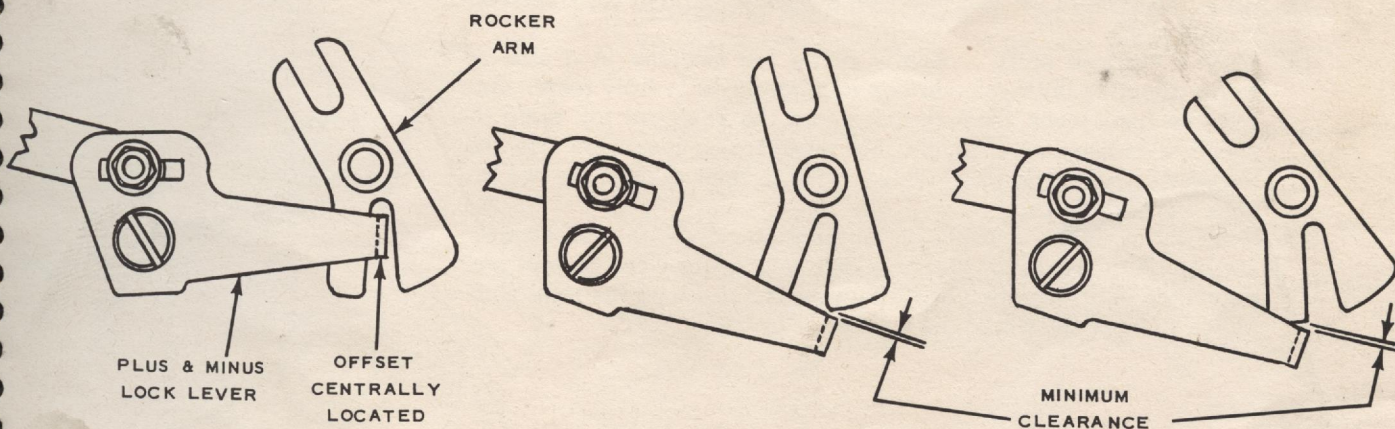
## SHIFT MECHANISM ADJUSTING SEQUENCE (CONT'D.)

### AUTOMATIC DIVISION SHIFT

3. Reconnect the two linkages to the shift clutch arms and adjust the nuts in the elongations to permit the shift arms to be fully seated in the shift drums.
4. Alternately depress each shift key as far as possible. Adjust each stop washer to permit each shift clutch arm to clear the rim of its shift drum by approximately .020".
5. Machine in Neutral: Slowly depress a shift key. Form the forward offset of the carriage raising toggle breaker arm, operated by the bracket on the right end of the shift universal bail, to break the carriage raising toggle when the shift clutch arm is about halfway out of the shift drum opening.
6. With the carriage raising toggle broken for a carriage shift, adjust the eccentric stud on the carriage raising arm against the carriage raising toggle platform so as to raise the carriage about .030".



7. With the carriage raised for a shift and the tip of the shift clutch arm in the opening above the shift drum's clutch pawl, adjust the plus and minus rocker shaft lock to obtain two conditions.
  - a. For minimum horizontal clearance, adjust the nut in the elongation.
  - b. Reform the offset to centrally locate in the opening on the plus and minus rocker blank.



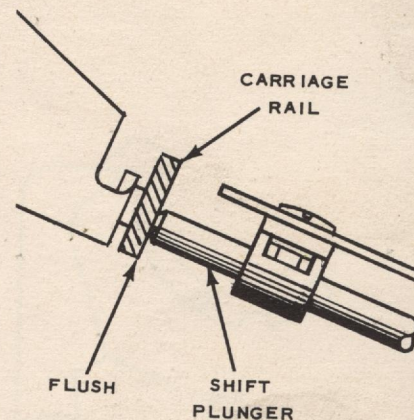
The function of the plus and minus rocker shaft lock is to lock the plus and minus rocker shaft during carriage shifts and during clearing functions. Also, to prevent movement of the universal bail when a plus or minus key is depressed.



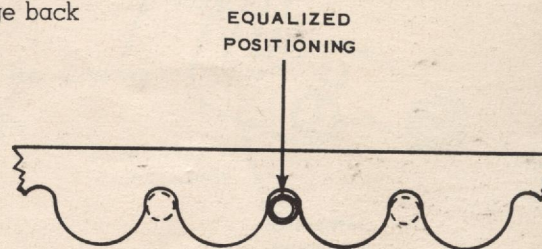
## SHIFT MECHANISM ADJUSTING SEQUENCE (CONT'D.)

### AUTOMATIC DIVISION SHIFT

8. With a shift clutch arm in the opening above the clutch pawl, check the switch closing adjustment. If necessary refine this adjustment, and under the same condition reform the shift plunger yoke on the shift universal bail to permit the shift plunger to be flush with the front edge of the scallop carriage rail.



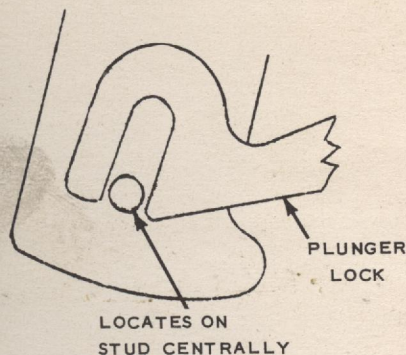
9. Alternately rotate each shift drum. Check for equalized positioning of the carriage plunger on the scallop edges as the shift arms enter the drums. If adjustments are necessary readjust the carriage back plate as explained in the carriage adjustments.



10. Adjust the shift clutch arm interlock, located on the rear cross frame, to perform its function, namely to alternately lock one shift arm in its inactive position while the other is in its active position.
11. Align the booster latches to ride squarely on the shift drums' booster cams.
12. After a carriage shift, manually rotate the machine in a plus or minus direction until the carriage raising toggle is fully reset. Adjust the limit blank located underneath the keyboard top plate to permit a minimum over-toggle, but enough over-toggle so that the toggle will not break when tested. (Raise front of machine two inches and then drop).
13. Manually cycle the machine in an automatic division plus bumper stroke. With the cycle stopping arm held against the bumper pad reform the shift operating arm's forward end to cause the right shift clutch to clear the rim of the shift drum by about .020".



## PLUNGER LOCK FUNCTION and ADJUSTING SEQUENCE

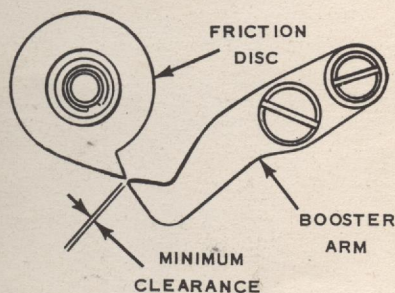


The function of the plunger lock mechanism is to lock the clutch yoke in neutral during any carriage shift operations.

Adjusting the plunger lock should not be attempted until the clutch yoke and the functional shift adjustments are correct.

### ADJUSTMENTS:

1. Clutch yoke in neutral notch: Adjust the hexagon eccentric in the left side frame to permit the inverted "U" to centrally locate on the stud of the clutch yoke.
2. With a shift clutch arm in the opening above the shift drum's clutch pawl, adjust the connecting levers via the two set screws and elongations to permit the "U" lock to engage the pin on the clutch yoke with a 3/4 hold.
3. Machine in Neutral: Adjust the booster arm to clear the friction disc with minimum clearance.



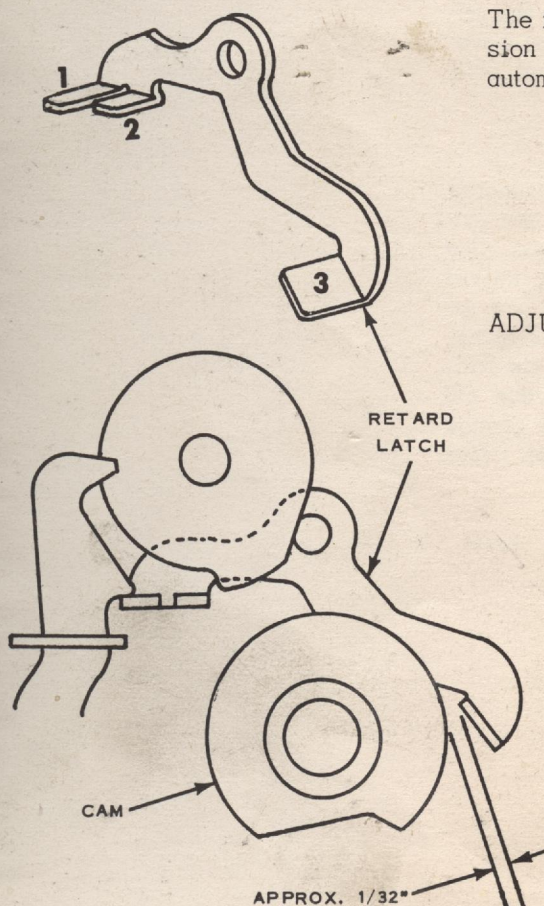
## RETARD LATCH

### FUNCTION AND ADJUSTMENT:

The function of the retard latch is to prevent the clutch yoke automatic extension from operating the clutch yoke while machine is held off center during automatic division shifts.

### ADJUSTMENTS:

1. Machine in Neutral: Adjust #1 lug by reforming to create a 1/32" clearance between #3 lug and the cam on the jack shaft.
2. Cycle the right hand shift drum until #2 lug has received its maximum movement from the camming surface of the retard latch cam. Form #2 lug to permit #1 lug to locate under the offset of the clutch arm, (as the shift clutch arm starts to enter the drum opening), with minimum clearance.
3. Cycle the machine halfway through the automatic division shift. If necessary reform #3 lug to cause the flexible latch of the cycle stopping arm to clear the forward end of the regular trip lever by 1/32" to 1/16".



**NOTE:** If this adjustment seems to be entirely out of proportion, check the timing of the machine rock arm driving gear.



## AUTOMATIC DIVISION FUNCTION

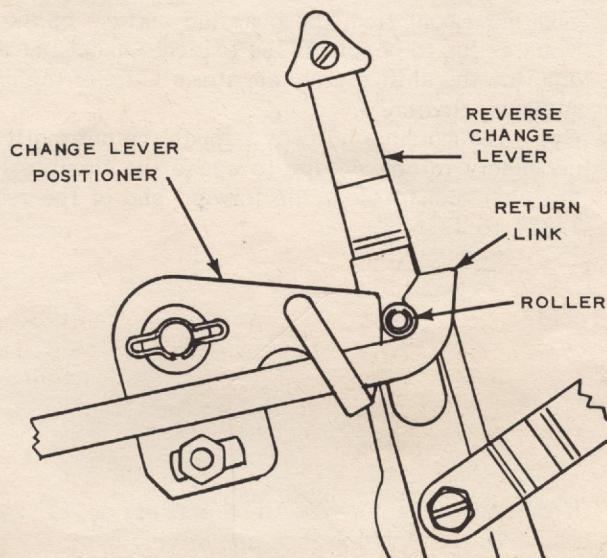
(Change lever in active forward automatic  $\div$  position)

Stage I. As the division lever is moved to the rear, the pin on the division lever contacts the triangular flipper on the clutch yoke rocker assembly. The eccentric stud engages the upright extension of the clutch yoke. Through the connecting bracket connecting the two sections of the clutch yoke, the minus arm offset is positioned into the path of the subtraction spider. Further movement of the division lever causes the clutch yoke extension latch to move into its active position. The clutch yoke operating extension is now latched in its active position. The division lever is held in its active position by the forward step of the division lever position holding arm.

Stage II. As the division lever was moved to the rear, the division slide was moved rearward also.

- A. The division lever restoring arm was also positioned rearward.
- B. The interlock moved into position above the stopping lever assembly's spring stud, locking this assembly, to prevent plus and minus key depressions.
- C. A pin on the division slide raised the rear of the universal bail lock high enough to permit the sublatch to move under the offset of the lock. The universal bail is now locked against movement thus preventing manual dial clearing and manual shift functions.
- D. The automatic  $\div$  shift coupling has been coupled.

Stage III. As the division lever was moved to the rear, a linkage connected to the pin on the division lever pivots a cross shaft. An arm pinned on the right end of this cross shaft operates two linkages. One of these linkages is connected to the repeat non-repeat swivel thereby pulling the repeat key down. The other connecting link operates the adjustable stud on the change lever positioning blank. As the change lever positioning blank is operated against the roller stud on the change lever this lever is moved to the rear and locks in this position. Also, a guide strap has raised the change lever return link to engage the roller on the change lever. (See Illustration).





## UPPER DIAL CLEARING MECHANISM

Stage IV. Machine cycling: Since the clutch yoke is in minus, the machine cycles in minus, subtracting the amount on the keyboard out of the lower dials until a carry-over trip is obtained. The forward end of the trip lever is raised above the flexible latch of the cycle stopping arm. The cycle stopping arm is driven to the bumper pad, neutralizing the clutch yoke. As the cycle stopping arm returns from the bumper stroke, the pin on the connecting link drive gear contacts the clutch yoke extension thereby moving the clutch yoke into plus for a cancellation cycle. The machine cycles in plus cancelling the nines out of the lower dials and again a trip is obtained. The cycle stopping arm is again driven to the bumper, neutralizing the clutch yoke. At this time, however, the roller stud on the connecting link is in an upward position raising the shift operating arm's rear extension. The forward end of the shift operating arm causes a downward depression of the shift platform, and through the shift coupling the cross shaft, operates the shift universal bail. An arm on the right end of the shift universal bail breaks the carriage raising toggle, and, through linkage, the right hand shift arm is pulled out of the right hand shift drum. As the shift clutch arm was being withdrawn from the drum, the retard latch was released. This permitted its forward lug #3, to drop into blocking position in the jack shaft cam. This prevents the full return of the machine to its normal stopping position.

The carriage shifts one position to the left. Near the completion of the shift drum cycle the #2 lug on the retard latch receives its maximum movement from the retard latch cam, thereby pulling the #3 lug out of the jack shaft cam opening. (approximately 1/8" before the shift nose enters the drum opening). As the shaft clutch arm enters the drum opening to stop the shift drum, the #1 lug on the retard latch is blocked under the offset on the shift clutch arm.

When the jack shaft cam was unblocked, the machine was permitted to complete its return to normal stopping position and the pin on the drive gear operates the clutch yoke lever, moving the clutch yoke into minus and the machine starts cycling in minus. The above functions are repeated.

NOTE: The plunger lock mechanism functions on each shift cycle of automatic division.

Stage V. As the carriage shifts into its extreme left position, a pin on the under side of the carriage positions on the top of the division lever restoring offset thereby lowering the division lever return blank into the path of the division lever restoring arm. On the first half of the minus cycle, the restoring arm, driven by a stud on the connecting link, engages the division lever restoring blank thereby driving the division lever forward to neutral.

As the division slide moved forward;

- A. The pin on the division lever located in the rear step of the division lever locating blank and in the path of the upper camming surface of the automatic clutch extension latch.
- B. The stopping lever assembly's interlock is pulled away from the spring stud.
- C. The pin on the division slide has moved away from the rear extension of the universal bail lock. (The lock is still held active by the sublatch).



## LOWER DIAL CLEARING MECHANISM

- D. The shift coupling has divorced.
- E. When the division lever was restored, through linkage and the cross shaft, the change lever positioning blank was moved away from the roller stud on the change lever.

NOTE: The change lever return hook is still engaged with the roller.

The machine continues cycling in minus until a carry-over trip is obtained. The cycle stopping arm is driven to the bumper, neutralizing the clutch yoke. The sublatch unblocks the universal bail lock permitting this lock to normalize. The switch lock on the forward end of the switch closing arm takes over the blocking of the universal bail, both during the machine cycling and bumper strokes. When the cycle stopping arm returns from the bumper the pin on the drive gear engages the clutch yoke positioning blank moving the clutch yoke into plus. Inasmuch as the plus arm offset has 1/2 of its hold on the lug of the ring gear, the automatic clutch yoke extension latch is normalized. As the upper camming surface meets the pin on the division lever, the clutch yoke extension is normalized and can no longer receive impulses from the stud on the drive gear.

The machine cycles in plus for the last cancellation cycle. After a trip is secured, the cycle stopping arm is driven to the bumper pad; this time for one purpose only, to neutralize the clutch yoke.

NOTE: The sublatch is operated during each bumper stroke, however, as long as the division slide is to the rear, the pin on this slide prevents the universal bail lock from normalizing.

Stage VI. After the completion of a division function, when the operator depresses the keyboard clear key for the purpose of clearing the keyboard, the change lever return hook must position the change lever beyond its self-restoring point before the keyboard clear releases the numeral keys. The repeat key will remain depressed.

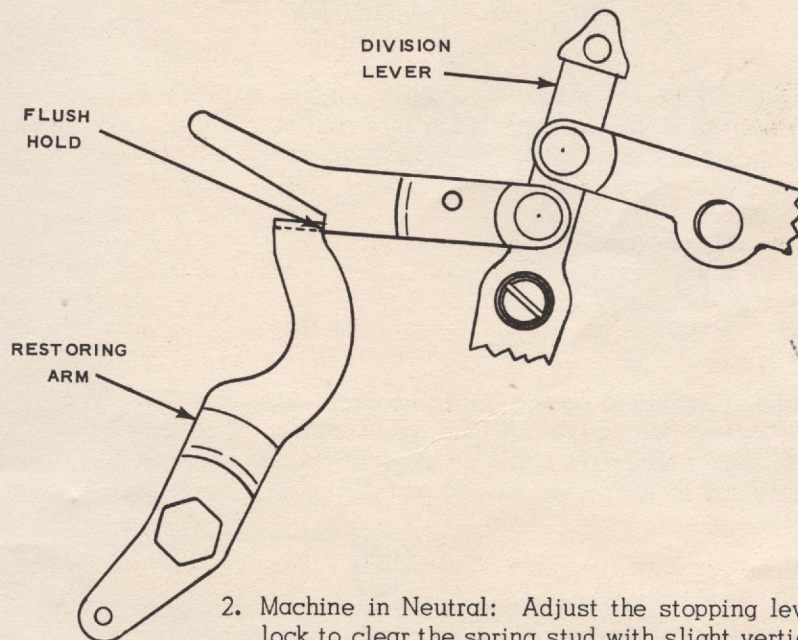
It will be noted that the Division explanation is divided into stages in the sequence in which the function is performed. The first three and the last stage are on an inactive machine. It is important that each stage in sequence is thoroughly understood before going into the next.

Another reason for breaking down this function is to eliminate confusion in trying to handle the whole function under one heading. In the final analysis the result will be the same.



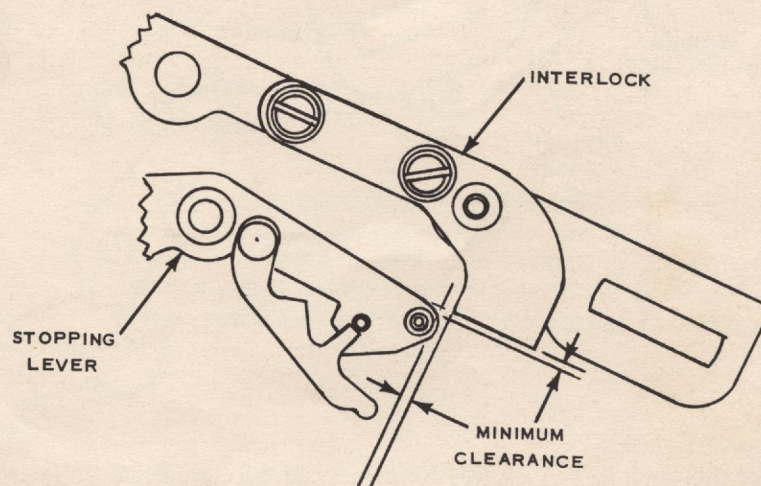
## DIVISION SLIDE ADJUSTMENT

1. Division lever to the rear and the carriage in its extreme left hand position and fully seated: Adjust the eccentric stud on the division lever restoring mechanism to permit a flush hold of the division lever restoring arm with the return blank.



2. Machine in Neutral: Adjust the stopping lever assembly's interlock to clear the spring stud with slight vertical and minimum horizontal clearance.

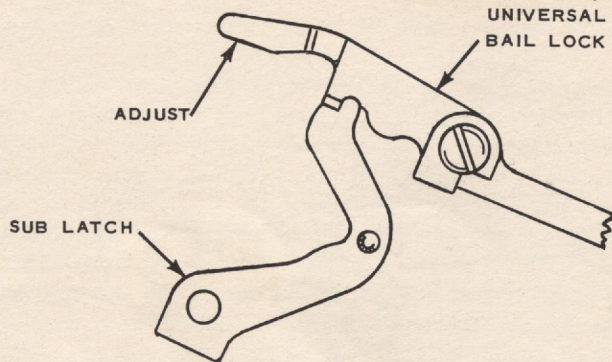
The function of this lock is to lock the division slide when the stopping lever assembly is active during plus or minus key functions, and to lock the stopping lever assembly during division functions, thus preventing plus and minus key operations.



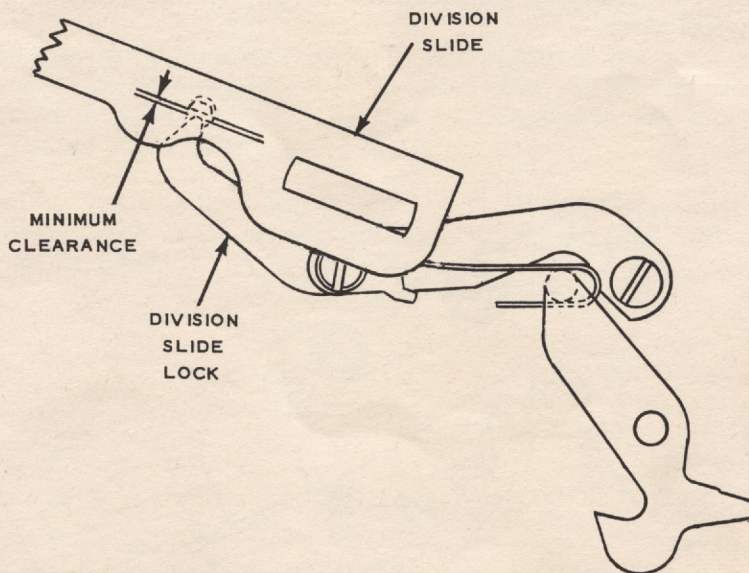


## DIVISION SLIDE ADJUSTMENT (CONT'D.)

3. Division slide to the rear: Adjust the rear extension of the universal bail lock by reforming it to raise the lock high enough to permit the sublatch to latch under the offset.



4. Check the shift coupling to couple and to uncouple when the division slide is moved into active and inactive positions. If adjustments are necessary reform the offset on the shift coupler to permit the flexible flipper to locate the forward end of the division slide earlier or later.
5. Machine in Neutral: Adjust the spring on the division slide lock to permit the triangular pin on the division slide to pass the point of the lock with minimum clearance.



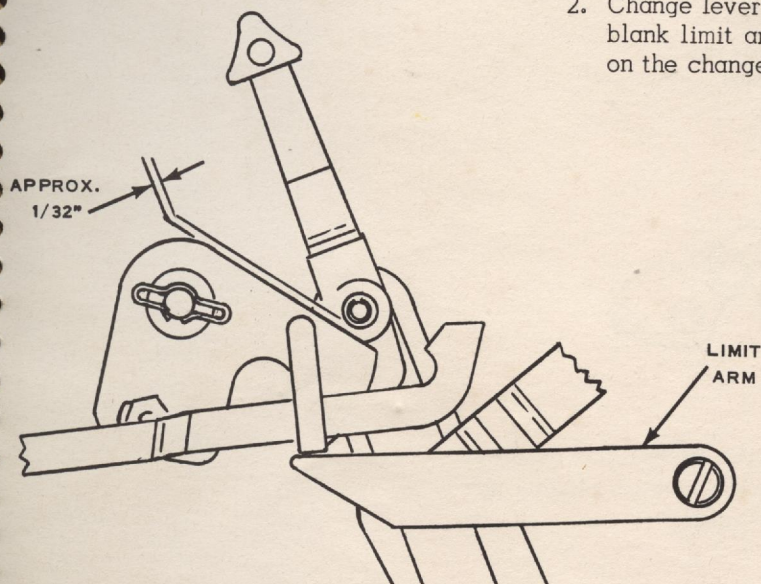
The function of this lock is to lock the division slide during manual shift and dial clearing functions.



## AUTOMATIC CONTROL of CHANGE LEVER and REPEAT, NON-REPEAT ADJUSTMENTS

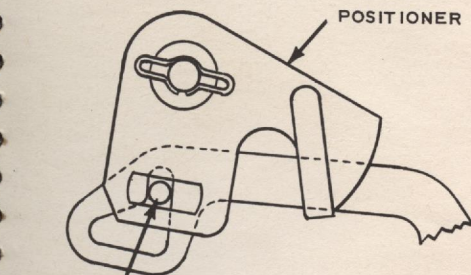
1. Machine in Neutral: Adjust the blank on the left end of the cross shaft so that it positions the arm (pinned to the right end of the same cross shaft). Adjust this so that the stud on this arm does not interfere with the free movement of the linkage connected to the repeat non-repeat swivel when the repeat and non-repeat keys are fully depressed.

2. Change lever in "X" position: Adjust the change lever positioning blank limit arm to create about  $1/32"$  clearance between the roller on the change lever and the positioning blank.



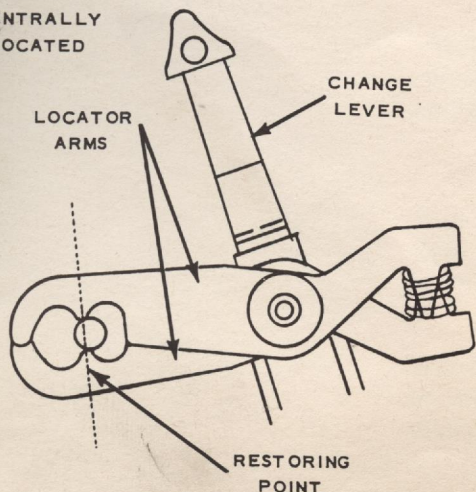
CHANGE  
LEVER  
POSITIONER

3. Change lever in "X" position and down: Set the adjustable screw stud in the elongation of the change lever positioning blank to centrally locate in the upper aperture as shown in sketch.



STUD  
CENTRALLY  
LOCATED

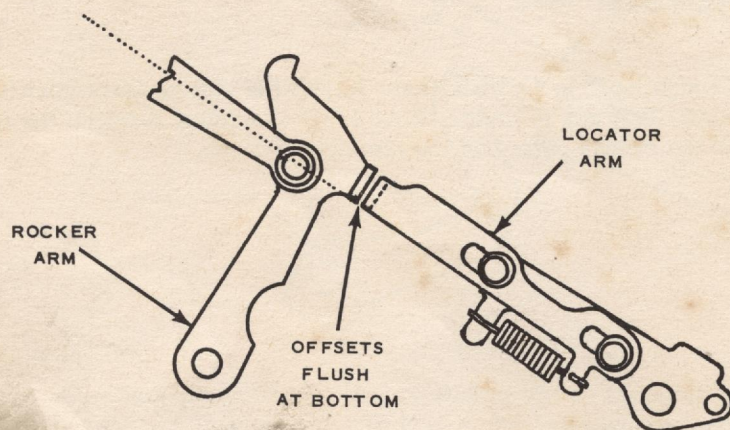
4. With the change lever in " $\div$ " position and the change lever return hook engaged with the change lever roller: Adjust the return hook bracket on the keyboard clear keystem to cause the change lever to move slightly beyond its self-restoring point before the numeral keys restore when the keyboard clear key is depressed.



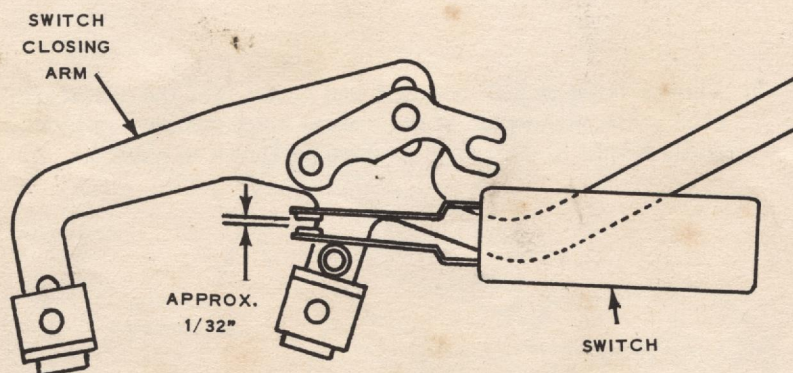


## LOCATOR ARM and CONTACT BLADES ADJUSTMENT

With machine mechanism in neutral position, adjust the locator arm through the medium of the adjusting blank on the switch closing arm to cause the offset on the locator arm to be flush with the bottom of the offset on the machine rocker arm.



With the contact blades parallel to one another, curve the lower blade until the contact points are  $3/32$ " apart. Adjust the blank on the contact closing arm against the insulator until the contact points are  $1/32$ " apart.



### OTHER TRAINING HELP

Many machine service bulletins pertaining to the MA-7 models have been released containing information which will supplement data contained in this training book. We suggest that you acquaint yourself with the contents of the following bulletins during your study of the MA-7 models.

#### MACHINE SERVICE BULLETINS

#277 SERIES	#320	#335	#361	#407
#304	#323	#345	#386	#422
#306	#324	#345A	#388	#432
#316	#334	#347	#402	

Other bulletins of a general nature are also available in your Branch Library. They will prove interesting in your understanding of the over-all Monroe Service Operation. Among this style of bulletins, the complete index of Service Kit Tools is contained in General Service Bulletin #G-508.







